PAST AND PRESENT PINES OF TURKEY*

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The genus *Pinus* L. comprises 66 species according to Shaw (1914), who employed a condensed classification by combining the related taxa, while Gaussen (1960) includes 120 species through a narrower species concept by raising the infraspecific taxa to the species level. Mirov (1967) in his monograph of the genus accepts 105 species, while Little and Critchfield (1969) recognize 94 species in the most recent classification of the genus *Pinus*. According to the distribution maps of the pines of the world by Critchfield and Little, the genus *Pinus* is distributed throughout the temperate zones of the northern hemisphere, dominating the forest lands more than any other conifer. *Pinus merkusii* Jungh & de Vriese is the only species of the genus which extends south of the Equator into Sumatra.

The highest concentration of species occur in the United States and Mexico, California alone having 19 species. Eurasia is another center of evolution with 34 species. Five distinct species are native to Turkey (Krause 1936, Birand 1952, Kayacık 1954, Davis 1965, Critchfield & Little 1966, Mirov 1967, Little & Critchfield 1969, Karamanoğlu, 1976). All five species of the Turkish pines belong to the Diploxylon section of the genus *Pinus* (Shaw 1914):

1) *P. brutia* Ten. = Turkish pine (Turkish name: Kızılçam)

2) *P. halepensis* Mill. = Aleppo pine (Turkish name: Halep Çamı)

3) *P. nigra* Arnold = Austrian pine (Turkish name: Karaçam)

4) *P. pinea* L. = Italian stone pine (Turkish name: Fıstık Çamı)

5) *P. sylvestris* L. = Scotch pine (Turkish name: Sarıçam)

The pines are the most dominant conifers of the forested land of Turkey. According to Güniz (1954), the total area of

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the forested land in Turkey is 10.5 million hectares and the share of the pine species of this total area is 38.5%. The total amount of timber produced in Turkey during 1954 (Güniz p. 15) was 1118 360 m^3 and more than half of this amount was obtained from the various pines (601 854 m^3 or nearly 54.5% of total timber production). The significance of pine products in the Turkish economy and their dendrological and silvicultural aspects have been thoroughly investigated by several Turkish foresters (Yiğitoğlu 1941, Fırat 1942, Oksal 1943, Berkel and Huş 1952, Gülen 1959, Alemdağ 1962, Saatçioğlu and Pamay 1962, Selik 1963, Eliçin 1971). However, I shall briefly point out the economic uses of the pine species of Turkey in the subsequent section of this paper.

I. The extant species of pines in Turkey:

1) Pinus brutia Ten., Prodr. Fl. Nap. I. 22, 1811.

(P. pityusa Steven in Bull. Soc. Nat. Mosc. XI. 49, 1838;
P. carica Don in Ann. Mag. Nat. Hist. VII. 459. 1841;
P. persica Strangways ex Endlicher, Syn. Conif. 157. 1847;
P. eldarica Medwejew in Act. Hort. Tiflis VI - 2, 21, f. 1902)

Pinus brutia is a diploxylon pine belonging to the Sylvestres subsection of the section Pinus (Little and Critchfield 1969). It is a two needle pine with light green foliage. The ovoid cones are sessile, reddish brown or grayish brown, several of them forming whorls around the branches, horizontally oriented and not pendent. The Turkish name Kızılçam (Red pine) refers to the reddish bark of the stems.

This pine is primarily an eastern Mediterranean species distributed throughout the coastal Mediterranean zones of Turkey (Kasapligil 1952, Selik 1963, Şefik 1964). Outside Asia Minor (Anatolia), it also occurs in Cyprus, Crete, Aegean islands, north eastern Greece, as well as in Pitsunda between Gagra and Gudauta, northwest of Sukhumi, Georgia, U.S.S.R., central Transcaucasus, and near Soichi and the Crimean peninsula on the Black Sea coast of Russia (see map 31 in Critchfield and Little 1966). There is, indeed, a close genetic relationship between P. brutia Ten. and P. halepensis Mill. Several authors including Shaw (1914) considered P. brutia as a variety of P. halepensis and called it P. halepensis Mill. var. brutia (Ten.) A. Henry (Bailey & Bailey 1976). However, the present writer (Kasapligil 1947, 1952) and several other authors in recent publications (Czeczott 1954, Mirov 1955, 1967, Bean 1976) regard these two pines as distinct species since they present sharply distinguishable morphological and biochemical characteristics along with their two separate main distributional areas, i.e. Pinus halepensis primarily in the western Mediterranean region and

P. brutia in the northeastern mediterranean region. In the areas of overlapping distributions, these two species hybridize and consequently intermediate forms are found in such areas, as in northwestern Greece, the Aegean islands, and in Syria.

Pinus pithyusa Strangw., P. eldarica Medw., and P. stankewiczii (Suk.) Fom., are three species of pines described from the Black Sea Coast of Russia and Central Transcaucasus. These are closely allied to Pinus brutia Ten. Both Malejeff (1929) and Gaussen (1960) treat them as varieties of P. brutia. Three years ago, while I was in Pitsunda about 40 km. northwest of Sukhumi (= Sukum Kale), in Georgia S.S.R., I had the opportunity to visit a fine stand of P. brutia var. pithyusa on the edge of the coastal sands. This forest consists of tall, handsome trees of uniform age, associated with semixerophillous mediterranean elements intermingled with mesophytic Pontian elements (cf. Kolakovsky 1962, 1975): Juniperus oxycedrus, Acer campestre, Rhus coriaria, Cotinus coggygria, Eryngium maritimum, Foeniculum vulgare, Ilex colchica, Hedera colchica, Periploca graeca, Asparagus litoralis, Tamus Communis, Smilax excelsa, Vitis silvestris, Berberis vulgaris, Ruscus ponticus, Carpinus orientalis, C. caucasica, Corylus pontica, Lonicera caprifolium, Celtis australis, Cistus incanum, C. tauricus, Helianthemum tomentosum, Arbutus andrachne, Quercus iberica, Origanum vulgare, Teucrium chamaedrys, Polygala albovii, Paliurus spina-christi etc. The vegetative and the reproductive organs I collected from the Pitsunda pines proved identical with those of P. brutia. During the excursion, I came across the oldest specimen of the Pitsunda pine, which was fenced in. "The Patriarch" tree was 35 m. tall and 2 m. in diameter. Its age was estimated at over 300 years. Unlike any other specimen of the P. brutia groups I have seen, the lower portion of the stem of the Patriarch tree was covered by burls of different sizes (Fig. 2).

I did not have the opportunity to visit the relict forest of P. brutia var. eldarica in Çoban dağ near Tbilisi, but I have seen the cultivated cone-bearing specimens of this variety in the Eddy Arboretum of the Institute of Forest Genetics in Placerville, California. It is indeed quite similar to P. brutia rather than to P. halepensis. Likewise, P. stankewiczii of the Crimean peninsula should also be maintained as a variety of P. brutia as suggested by Gaussen (1960).

Pinus brutia var. agraphiottii Papajoannou (1936), described from the Lesbos island of Greece, is characterized by deformed stems branching from the base forming a bushy, compact crown without a main axis. Recently Selik (1962) described a columnar variety from Balıkesir in northwestern Anatolia, naming it P. brutia var. pyramidalis, which seems to have an ornamental potential.

Until a few years ago, Pinus brutia was a popular item for street and garden planting as a shade tree in California. It was available for a nominal price in supermarkets as well as in variety stores under the name of Turkish pine. However, older trees I observed in the parks, private gardens, and on various campuses proved to be P. halepensis which had been introduced from the western mediterranean region at an earlier date. In its native land, P. brutia is used primarily for timber production because of its hard, durable wood. It is also an important source of oleoresin (Okay 1940).

Fossil record:

Kolakovsky (1965) reported the occurrence of eight different pines from the Tertiary period of western Georgia in the Caucasus. Two of these fossil pines, P. euxina Kolak. (= P. pontica Kolak. non Koch) and P. praepithyusa Palib. (= P. pithyusa Strangw. fossilis) are clearly related to Pinus brutia and it is most likely that these two fossil species represent the ancestral forms of the P. brutia group including the Caucasian varieties mentioned earlier. As I judge from the cone illustrations, the outline of the apophyses of the ovuliferous scales in P. euxina is quite variable ranging from quadrangular to hexagonal shapes while the apophyses of the extant P. brutia are mostly rhombiform although the apophyses near the cone apex of the latter species often approach polygonal outlines. The P. praepithyusa cone has a more or less cylindrical outline while the cones of the extant species are conical or ovoid. However, the ovuliferous scales of P. praepithyusa are quite similar to those of P. brutia since the apophyses exhibit horizontal keels. The upper edges of the apophyses in P. praepithyusa cone are rounded. Such cone scales with rounded apophyses along the upper edges are confined to the basal portion of the cone in the extant species.

A summary of the fossil taxa related to P. brutia Ten. is given below (After Czeczott 1954, Kolakovsky 1965, Nemejc 1968 and others).

Fossil taxa	Age	Locality
P. praepithyusa Palib.	Oligocene to Meothian	Western Transcaucasus
P. pithyusa Strangw. fossilis	Tertiary, upper Pliocene	Western Georgia, Abkhasia, S.S.R.
P. palibinii Dorof.	Sarmatian	Paman Peninsula, Azov Sea, U.S.S.R.
P. paraeuxina Kolak.	Sarmatian	Kavaklık Hills, Western Georgia, USSR

Fossil taxa	Age	Locality
P. paraeuxina Kolak.	Meothian	Kodor River, Abkhasia, S.S.R.
P. euxina Kolak.	Pontian strata	Kavaklık hills, W. Georgia, U.S.S.R.
P. sarmatica Palib.	Miocene	Crimean Coastal region, U.S.S.R.
P. wassoewiczi Palib.	Miocene, Sarmatian	Transcaucasus, Georgia, U.S.S.R.
P. salinarum Partsch	Lower Miocene	Wielitzka, Poland
P. sp. aff. brutia Ten.	Miocene	Zemplen Mountains, N.E. Hungary
P. ferreri Massal	Miocene	Sinigallia near Ancona, Italy
P. saturni Unger	Middle Miocene	Radojob, Yugoslavia

Recently, Aytuğ and Şanlı (1974) reported the occurrence of carbonized wood remains of Pinus brutia from the late Tertiary brown coal deposits at Ağaçlı on the Black Sea Coast near Bosphorus.

2) Pinus halepensis Mill., Gard. Dict. 8th ed. Pinus No. 8, 1768.

(P. maritima Lambert, Gen. Pin. I. 13, t. 10, 1803;
P. arabica Sieber ex Sprengel, Syst. Veg. III, 886, 1826;
P. pyrenaica David in Ann. Soc. Hort. Paris, 186, 1833;
P. hispanica Cook, Sketches in Spain, II, 337, 1834;
P. abasica Carriere, Trait. Conif., 352, 1855.)

Pinus halepensis is also a diploxylon pine from the Sylvestres subsection of the section Pinus. Aleppo pine is a two-needle pine, with slim and tender foliage 6-12 cm. long, yellowish green in color. According to Krüssmann (1972) and Bean (1976), the number of needles varies from two to three, but I personally did not see any specimens with three needles in this particular species although I observed variation in the number of needles in several other pine species. The most distinguishing characteristic of the Aleppo pine is the recurved condition of the ovulate cones on firm peduncles 10-20 mm. long, 6-10 mm. thick (Fig. 31). In a closed state, the seed cones are 5-10 cm. long and 3-4.5 cm. wide at the base. The mature cones remain attached to the trees for several years.

The Aleppo pine is primarily a western mediterranean species most abundant in Spain and the Balearic islands, but extending eastward less commonly through southern Europe to the mediterranean coasts of Asia Minor. In north Africa, it is distributed from Morocco to Libya in many isolated occurrences. Strangely enough, since it is not found in Aleppo, its name is misleading. However, it is indigenous to Israel, forming extensive forests in Gilead and reaching its southernmost limit near Hebron (Zohary 1973). It is the principal tree of the coniferous forests in northwestern Jordan (Kasaplıgil 1956 a and b). Isolated groves of P. halepensis occur along coastal areas of Syria, Lebanon, and Turkey. According to Dallimore and Jackson (1967), it is also a native of Cyprus, but the natural occurrence of the Aleppo pine in Cyprus requires verification.

The early records regarding the occurrence of P. halepensis in Turkey are based on cultivated material (Krause 1936). My first collections of this species were obtained during July 1944 from cultivated trees at the Stock Breeding Station in Çukurova, north of Adana (Birand 1952) during a field trip with Professor Savni Huş of the Forestry College at Istanbul. According to my field notebook, these cultivated specimens were transplanted from the "Sarıçam Forest," situated a few miles north of the station along the road to Kozan. Kayacık (1954) verified this locality and later, he discovered new localities (Kayacık 1973) which are marked on the distribution map. During the same field trip in July 1944, I made notes concerning the sympatric distribution of P. halepensis and P. brutia in the maquis around the Karayılanlı Village at an altitude of ca. 350-400 m., between Payas and Iskenderun. Unfortunately, I did not make specimens and this locality needs to be revisited for verification. The isolated distributions of Pinus halepensis in Turkey, Syria, Lebanon, Israel, and Jordan are an indication of the relict nature of this species in the Middle East.

Pinus halepensis is closely related to P. brutia and these two species cross naturally. However, it is a distinct species from P. brutia in regard to its chemical properties. The turpentine of P. halepensis is dextrorotatory while the turpentine of P. brutia is laevorotatory (Mirov 1955 and 1961). Likewise the needle anatomy of P. halepensis differs from that of P. brutia as described and illustrated by Selik (1963) and Harlow (1931). While P. brutia is resistant to the scale insect Matsucoccus, P. halepensis is susceptible to this disease. Another instance of a natural hybrid between P. halepensis and P. pinaster was reported by P. Schütt.

Pinus halepensis has several varieties which can be considered as ecotypes of diverse climatic zones of the western mediterranean region. It is noteworthy to mention P. halepensis var. algeriensis Gaussen described from Algeria. This variety is characterized by its profusely branched, compact form and by its large pollen wings.

Because of its irregular stem formation, Pinus halepensis is not as desirable as P. brutia for timber production. It is a source of oleoresins and of fuel wood. In Spain and in other parts of the western mediterranean region, it is used for erosion control and in afforestation since it is tolerant to heat and drought and can grow in poor soils.

Fossil records:

Apparently, *Pinus halepensis* had a wide distribution during the Tertiary period. It extended from the shores of the Tethys sea to Poland in northern Europe and penetrated the central Anatolian plateau during the Miocene. This is verified by the recent discovery of *Pinus halepensis* ssp. *alpanii* in the Gürcü Valley of Güvem village near Kizilcahamam about 90 km. north of Ankara. Here I would like to summarize the list of the fossil taxa related to *P. halepensis* from the available literature. However, this is not a conclusive list and the correct identity of these fossil materials deserves a thorough revision. Possibly, many of these binomials are synonyms.

Fossil taxa related to *P. halepensis* Miller (after Czeczott 1954, Gaussen 1960, Nemejc 1968 and Klaus 1977)

Fossil taxa	Age	Locality
P. consimilis Sap.	Miocene	Rochesaure, Ardèche, France
P. cortesii A. Brong.	Tertiary	Northern Bohemia, Czechoslovakia; Dürkhelm, Lower Main Valley, Germany.
P. hageni Heer	Lower Miocene	Baltic region.
P. halepensis Mill.	Upper Miocene, Pannon E.	Near Vienna, Austria
P. halepensis Mill.	Pliocene	Sofia, Bulgaria; Romania
P. halepensis Mill.	Pleistocene	Saint Martial, Gard, France.
P. h. var. *algeriensis* Gauss.	Pleistocene	Pollen grains from Ahaggar (Hoggar) Mountains in Southern Algeria.
P. h. var. *atavorum* Marion	Plio-Pleistocene	Saint Marcel near La Valentine, France.
P. aff. *halepensis* Mill.	Middle Miocene	Leoben, Austria.
P. hepios Ung.	Tertiary	Serbia, Southern Yugoslavia; Lower Main Valley, Germany.
P. hepios Ung.	Pliocene	Northern Bohemia, Czechoslovakia.

Fossil taxa	Age	Locality
P. kotshiana Ung.	Miocene	Zemplen Mountains, northeastern Hungary; Transylvania, Romania.
P. leptophylla Sap.	Oligocene	Armisan, France
P. macroptera Sap.	Miocene	Near Narbonne, Southern France.
P. ornuta Stern.	Pliocene	Bohemia, Czechoslovakia.
P. platyptera Sap.	Oligocene	Armisan, France
P. pultonis (Bailey) Sew.	Eocene	England
P. salinarum Partsch.	Lower Miocene	Wielizca, Poland
P. setiformis Sap.	Oligocene	Armisan, France

Pinus plutonis (Bailey) Sew. illustrated by Gaussen (1960, p. 218, fig. 364/7) after Gardner is represented by three slender cones each with separate peduncles derived from a common stalk. This material seems to be quite remote from P. halepensis since the apophyses of the cone scales are mostly hexagonal and lack the transverse keels. It may represent a teratological specimen.

3) Pinus nigra Arnold, Reise Mariazell 8, t, 1785.

(P. laricio Poiret in Lamarck, Encycl. Meth. 5, p. 339, 1804; P. halepensis Bieb. (not Miller), Fl. Taur. Lauc. 2, p. 408, 1808, P. pinaster Besser (not Aiton), Fl. Gallic., 2, p. 294, 1809; P. maritima Aiton (not Lambert), Hort. Kew 5, p. 315, 1813; P. sylvestris Baumgart. (not Linn.) Baumgart, Stirp. Transsilv. 2, p. 304, 1816; P. pyrenaica Lapeyrouse, Hist. Pl. Pyren., Suppl. 146, 1818).

This species, having a wide distribution throughout central and southern Europe from Spain to Turkey, has several subspecies depending upon its genetic populations confined to isolated occurrences, altitudinal ranges, island adaptations. The Turkish materials I examined in the field or in herbaria may be referred to P. nigra ssp. pallasiana (Lamb.) Holmboe in Berg. Mus. Skr. 1, p. 29, 1914 (P. pallasiana Lamb. Pin. 2 ed. 2, 1828; P. laricio var. pallasiana Antoine, Conif. 6, 1840; Asch. and Graebn. Syn. 1, 2 ed. p. 333; E.V. Wulff, Fl. Krimea 1, 34; P. laricio M. Bieb. 3, p. 623, 1819; P. maritima Pall. Ind. Taur. p. 59, 1795; P. nigra var caramanica Rehder Man. Cult, trees N. Amer. p. 61, 1927; P. pinaster Stev., Verz. Taur. wildw. Pfl. 2, 1857; P. nigra Antoine var. pallasiana Antoine ex Bernhard, Mitteil. d. deutsch dendrolog. Ges. 39, 1931; P. fenzlii Ant. and Kotschy ex Carr., Traite gen. Conif. p. 496, 1867).

The Turkish black pine is a diploxylon pine with two needles and it belongs to the subsection Sylvestres Loud. of the section Pinus (Little and Critchfield 1969). It is characterized by dark green, stiff needles, 8-18 cm. long, brownish yellow twigs which match the color of the sessile cones, 5-10 cm. long, at maturity. The apophyses of the cone scales are more or less rhombic but often exhibit rounded upper edge, especially in the scales at the cone base or among those near the cone apex. The umbos are ovoid or rhombic with a short persistent mucro at maturity.

Pinus nigra Arnold ssp. pallasiana (Lamb.) Holmboe is widely distributed in northern, western and southern Turkey (see the map). The isolated groves of this pine are scattered in central Anatolia like little islets within the vast steppes (Kasaplıgil 1960), mostly associated with Quercus pubescens Willd. and other oaks. In Russia, it occurs along the Black Sea coast of the Crimean peninsula, which is the type locality of this subspecies. In the fall of 1976, while botanizing along the Black Sea Coast of Eastern Thrace, I saw fine stands of this pine between Kıyıköy (=Midye) and Kasatura (=Kastros) associated with Quercus hartwissiana, Arbutus unedo, Calluna vulgaris, Erica verticillata, Osyris alba and several other mediterranean elements. The Black pines in this locality were 15-20 m. high with the diameters ranging from 50-75 cm. at breast height. The oldest specimens in this forest were approximately 150 years old and they were branching into 2-3 sizeable stems at breast height. I was pleased to notice the abundance of young seedlings of all ages on the forest floor, which is a good indication of a successful regeneration. Many trees near the Black Sea Coast of Kasatura were destroyed by a forest fire in 1966 and such areas deserve immediate reforestation with the same subspecies.

Pinus nigra has several geographical varieties such as var. austriaca Endl. (Austrian pine), var. corsicana Endl. (Corsican pine), var. pyrenaica Grenier and Gordon (Pyrenese pine), var. calabrica Loudon (Calabrian pine) of Sicily and southern Italy. In addition to these, many horticultural varieties with golden or yellow leaves and dwarf, prostrate or drooping forms are well known garden favorites and readers are referred to Krüssmann's (1972) comprehensive descriptions. The closest relative of P. nigra is P. heldreichii Christ of the Balkan peninsula which is recognized as a distinct species by most recent workers, although it was submerged into P. nigra by Shaw (1914). An artificial hybrid between P. nigra Arnold and P. resinosa (N.E. United States and Canada) was described by Critchfield (1964) and Little and Righter (1965).

P. nigra ssp. pallasiana is a valuable timber tree for construction purposes. It also furnishes fuel wood and is a source for turpentine and rosin. In Turkey, it grows mainly in calcareous soils and can tolerate drought and low temperatures.

The ancestral forms of P. nigra are known from the Lower Cretaceous of Europe. The only fossil record pertaining to Turkey is based on thirteen carbonized wood specimens from the brown coal deposits of the late Tertiary period located at Ağaçli near Bosphorus which is not far from the Kasatura forests mentioned above (see Aytuğ and Şanlı 1974). The related fossil taxa from the countries neighboring Turkey and from other localities are summarized below.

Fossil taxa related to P. nigra (After Gaussen 1960, Mirov 1967, Nemjc 1968 and others)

Fossil Taxa	Age	Locality
Pinus fittoni Carruth	Lower Cretaceous	England
P. heidingeri Ung.	Pliocene	Styria and Piedmont, N.W. Italy
P. hampeana Ung.	Miocene	Switzerland; Steiermark (Austria); Greece.
P. junonis Kovats.	Miocene (also Pliocene)	Erdöbenye, Hungary; Rochessauve aux Coirons, Ardeche, France
P. jovis Ung.	Miocene	Radaboj, Croatia, Yugoslavia
P. laricio Eng. & Kink	Tertiary, Pliocene	Lower Main Valley, Germany; Northern Bohemia, Czechoslovakia
P. laricio Ettingh.	Miocene	Leoban, Steiermark, Austria.
P. laricio Poir.	Pliocene	Sofia, Bulgaria.
P. laricio Poir.	Miocene, Tortonian	Slatiora, Romania.
P. laricio Poir. fossilis	Oligocene, Lower Miocene	Central Europe
P. laricioides Ung.	Oligocene, Lower Miocene	Central Europe
P. laricioides Menzel	Pliocene	Northern Bohemia, Czechoslovakia
P. aff. laricio Poir.	Oligocene	Samland, Eastern Prussia
P. laricio thomasiana Heer	Oligocene	Baltic Region
P. aff. laricio pliocenica Kink.	Upper Pliocene	Lower Main Valley, West Germany
P. laricio var. salzmanni Sap et Plan (= P. Pyrenaica Sap)	Pleistocene	Tuff deposits of Montpellier, S. France

Fossil Taxa	Age	Locality
P. massalongi E. Sism.	Miocene	Chieri, Piedmont, N.W. Italy
P. microcarpa Sap.	Oligocene & Miocene	Armissan, France
P. nigra Arnold	Pliocene	Romania.
P. nigra Arnold	Late Tertiary	Ağaçlı, Black Sea Coast, Istanbul, Turkey.
P. nigraeformis Bolkhov.	Cretaceous	Moscow Province, USSR
P. repanso-squamosa Ludw.	Miocene	Wetterau, Prussia
P. schnittspahni Ludw.	Miocene	Wetterau, Prussia
P. thomassiana (Goepp.) Reich.	Oligocene	Silesia, Poland.
P. thomassiana (Goepp.) Reich.	Oligocene, Lower Miocene	Central Europe
P. thomassiana (Goepp.) Reich.	Miocene	Kaliningrad (formerly Königsberg) USSR.
P. thomassiana (Goepp.) Reich.	Middle Miocene	Søby-Fasterholt, Central Jutland, Denmark.
P. thomassiana (Goepp.) Reich.	Pliocene	Kodor River, Georgia, U.S.S.R.
P. trichophylla Sap.	Oligocene	Armissan, France

Among these fossil taxa, *P. thomassiana* (Goepp.) Reich. is the species most frequently encountered in Europe. Kilpper (1967) reported the occurrence of a diploxylon pine closely related to *P. thomassiana* from the Tertiary of Fortuna-Garsdorf in the lower Rhine Valley. As far as I know, the northernmost Tertiary distribution of this fossil species was reported by Christensen (1975) from Central Jutland in Denmark. The compressed cones illustrated in his plate 1, figures 1-4, show remarkable similarity to the recent material. Apparently, the ancestral forms of *P. nigra* had much wider distribution than the extant species, reaching the Jutland peninsula in northern Europe and the Caucasian region in the east.

4) *Pinus pinea* L. Sp. Pl. 1000. 1753;

(*P. sativa* Lamarck, Fl. Franç. II. 200. 1778;
P. maderiensis Tenore in Ann. Sci. Nat. Ser. 4, II. 379. 1854).

This nut pine belongs to the subgenus *Pinus* and to the section *Pinea* and to the subsection *Pineae* (cf. Little and Critchfield 1969, p. 11). It is a two needle pine with large woody cones which require three years to mature (Fig. 4). The edible seeds are large with thick shells and rudimentary wings which detach readily.

The natural distribution area of the Italian stone pine extends from the Iberian peninsula through the Mediterranean islands and southern Europe to Turkey. Because of its nutritious seeds and widely spreading crown upon aging, this pine has been under cultivation for many centuries in the Mediterranean region as well as in other parts of the world with a mild Mediterranean climate. Fırat (1942, p. 15) gives a detailed account of the authenticity of the distribution of this pine in Turkey. It forms extensive pure stands in Kozak near Bergama (Pergamus) in western Turkey and between the Aksu and Manavgat rivers on the way from Serik to Side in southern Anatolia. Other localities of natural stands are between Aydın and Milos, Ayvalık (cf. Karamanoğlu 1976), along the Bay of Edremit and the vicinity of Gemlik (Kayacık 1957). The sizeable, old specimens along Bosphorus (Fig. 6) represent cultivated material as pointed out by Krause (1936). The isolated groves are located in Onsan Village near Maraş, Iskenderun (Alexandrette) in southern Turkey, and Düzköy (Kalanema) 20 km. south of Akçaabat and Çoruh Valley were botanized by Radde (1899) who gave a detailed description of the Pinus pinea forests he observed on the left slopes of the Çoruh river near the village of Naşviye (=Naswia). According to Radde (pp. 126-127), the name of the village is derived from the local name of Pinus pinea and that the pinion cones were sold for the extraction of the edible nuts in the markets of Artvin under the same name. Today, the same locality is known as "Fıstıklı" which is the Turkish equivalent for pine nuts. "Naşviye" is not a Turkish word and I assume it represents a Georgian term applied to the pine nuts since the Georgian language is spoken commonly among the villagers and forestry workers, even at the present time, in the vicinity of Artvin.

Bernhard (1929-31), Fırat (personal correspondence 1965) and Kayacık (1965) suggest that the stands of the pinion pine near Artvin possibly represent an introduction by man. During the summer of 1964, I visited Artvin and the Çoruh Valley for the first time while studying the variation and distribution of Corylus along the Black Sea Coast of Turkey. I was very impressed with the park-like aspect of the P. pinea stand near Fıstıklı Village about 7 km. west of Artvin on the way to Hatila Valley (Fig. 3). The trees were equally spaced, 8-10 m. high and their diameters at breast height ranged from 30 cm. to 40 cm. Age determination was made by obtaining core samples by an increment borer from selected trees as well as by counting the growth layers on the stumps of fallen trees. The average age of the stand was calculated 80 years, coinciding with the year A.D. 1884 during which northeastern Turkey was occupied by the Russians following the Russo-Turkish war, 1877-1878. Artvin, Kars, Ardahan, Bayazit, Sarıkamış, and Erzurum remained under the Russian occupation until 1918 when the northeastern provinces of Anatolia were returned to Turkey upon a treaty with the Bolshevik forces. Curious elderly villagers stopped by to chat with me during my field work in the pinion pine forest near Artvin. Some of them did claim that this forest was established by planting during the Russian administration of the area. I checked this point through the foresters and old archives at the forestry headquarters in Artvin, but my attempts were fruitless since no one could find any written document about the past history of the pinion pine forest. I went back to the forest again and reexamined the vegetation associated with the pinion pines for an inventory. The typical mediterranean elements were abundant in the accompanying flora.

Twelve years later, I visited the Fıstıklı locality of Artvin, in September 1976. This time, I was accompanied by Prof. Daniel Axelrod and by several foresters from the forest districts of Trabzon and Artvin. My first impression was that the pinion pine stand had been heavily grazed and that the best specimens with straight stems and widely spreading umbrella-shaped crowns were selectively cut and removed, possibly for construction purposes by the encroaching villagers around the forest. Woody plants and the herbaceous perennials in the undergrowth were in prostrate forms under grazing pressure and the soil surface was largely exposed without any plant cover in many places. The eastern and northeastern slopes have a land inclination of 70% where I could hardly stand straight without leaning against a tree or holding on to the creeping shrubbery. The lower edge of the forest starts from 150 m. from sea level reaching the altitudes between 600 and 650 meters along the upper edge. The animal trails along the contours were my "life saver" to botanize within the pine stand. Once more, I collected and inventoried the accompanied flora many of which were typical members of the mediterranean maquis. I had the feeling that the pinion pine was really in its homeland with all its natural associates until I discovered the gulleys where the basal portions of the pinion pines were completely eroded, exposing the bottoms of the stems constricted by girdling of the lateral roots. Fig. 10 depicts one of these typical constructions which can easily be fatal in individual trees during further stages of development. In nursery practice, it is well known that pine seedlings raised in containers become root bound with the lateral roots strangling the main root or the base of the hypocotyl. That is why the young seedlings undergo root pruning upon transfer to larger containers during transplanting for afforestation or reforestation practices as a routine procedure. This common practice was not known until recently, hence, in all probability the pines of the Fıstıklı village by Artvin were cultivated by man, possibly during the Russian occupation which coincides with the ages of the oldest trees. During my recent visit last fall, I took four core samples from the oldest specimens I could select. The ages were 76, 80, 83, and 92 (the sample tree in fig. 10 being 83 years old). The oldest specimen was dated back to the year 1884, thus coinciding with the Russian period. The pinion pine occurs in cultivation in Mingrelia (Caucasus) as well as in the southern shores of Crimea (Komarov 1934) which might have been introduced during the early kingdoms of Pontus and Colchis. Both of these kingdoms had extensive sea trades throughout the Black Sea coasts as well as with the Mediterranean countries. Pinion nuts were among the important commodities of the early civilizations and have been carried around through the early routes of human migration for centuries. Teamwork between archeologists and botanists may discover the origin and dispersal of Pinus pinea which is primarily a western Mediterranean element. The Tertiary fossils of P. pinea from Turkey were reported by Aytuğ and Şanlı (1974) from the brown coal deposits at Ağaçlı locality near Bosphorus. Zodda (1903) reported the occurrence of a Pinus pinea fossil from Messina in Sicily, but one would expect additional new fossil findings of Pinus pinea from the Iberian peninsula where it forms extensive forests in diverse environmental conditions.

Another locality for Pinus pinea in the Black Sea coast was reported by Hendel-Mazzetti (1907) from the Kalanema valley, southwest of Trabzon. Last fall, we entered this valley from the coastal town of Akçaabat, 12 km. west of Trabzon. The modern name for the Kalanema valley is Söğütlü dere which is also known as Düzköy deresi. We penetrated the valley up to the Düzköy village (Kalanema) 20 km. by a stabilized gravel road following the river bed where the main type of rock consists of agglomerates containing andesite. The vegetation of this valley is lush green with mesophytic broadleaved trees such as Alnus barbata, Platanus orientalis, Carpinus orientalis, C. betulus, Populus nigra, Cornus mas, Ulmus campestris, Diospyros lotus mixed with a few mediterranean elements such as Arbutus andrachne, A. unedo, Pistacia terebinthus, Olea europea, Ficus carica, etc. Scattered Pinus pinea stands occur on both sides of the valley between the elevations of 50 m. to 500 m. In Yeşiltepe (Vasil or Vazil village), at the altitude of 320 m. above sea level, the residual small stands of rather young pinion pines were severely pruned (Figs. 7 & 9) by the villagers to be used as fuel wood. The principal rock of these steep slopes is augite olivene basalt exposed by soil erosion. Core samples obtained from the three largest specimens revealed their ages to be 40, 54, and 75 years. Professor Fırat informed me that he counted 70 growth layers on a stump 43 cm. in diameter when he visited the same locality in 1949. According to the information Professor Fırat gathered from the villagers, the older specimens with straight boles were extracted selectively and transported by the river to Akçaabat for timber and the remaining stands were maintained by cultivation for fuel wood extraction. In Yeşiltepe locality, the pinion pines are associated with Prunus laurocerasus, Cydonia oblonga, Acer campestre, Alnus barbata, Carpinus orientalis, Quercus petraea, Corylus pontica, Pinus sylvestris ssp. hamata, and with a few Mediterranean elements such as Juniperus oxycedrus (arboreal forms), Cistus salviifolius, Ficus carica and Olea europaea. Most probably, like the figs and olives, pinion pines have been naturalized in this locality through the years, since the area in question was one of the early settlements of the Pontian Kingdom, 6th century B.C. (cf. Hammond's Historical Atlas 1963). The pinion pine stands of the Yeşiltepe locality (old Vasil village of Kalanema) are interspersed with corn fields and vegetable gardens in small lots where tobacco, eggplants, tomatoes, green peppers, string beans, cabbages, pumpkins, squashes and hazelnuts are cultivated. With the exception of the native filberts, all the vegetable crops are introduced to this area and it is quite possible that the pinion pines represent one of the earliest introductions.

Pinus pinea wood is utilized as timber for construction and fuel. According to Baytop (1963), the stem wood contains 7.75% oleoresin and the seeds are an export item, each tree yielding an average of 6-8 kg. (11-15 lbs.) of shelled pinion nuts.

5) Pinus sylvestris L. Sp. Pl. 1000, 1753.

(P. rubra Miller, Gard. Diet. ed. 8, 1768; P. tatarica Miller, Gard, Dict. ed. 8, 1768; P. mughus Jacquin (not Scopoli), Icon. Pl. Bar. 1. t. 198, 1781; P. resinosa Savi (not Aiton), Fl. Pisa, 2. 354, 1798; P. humilis Link in Abhandl. Akad. Berlin, 171, 1827; P. frieseana Wichura in Flora 42, 409, 1859; P. regensis Desf. Cat. Hort. Paris Arb. 2, 61.)

The so-called "Scotch pine" occupies a larger distribution area than any other species in the genus. Latitudinally, it extends from the Scandinavian peninsula to the Iberian peninsula in western Europe and longitudinally from Scotland to the Sea of Okhotsk in eastern Siberia. Due to the fact that Pinus sylvestris grows under a great variety of edaphic and climatic conditions, it has many ecotypes. The continuity of the general distribution area of the Scotch pine was disrupted by geological changes during the Tertiary period and by the following glaciations of the Neogene which resulted in geographical isolations and many geographical races. Therefore, the Scotch pine is a very complex species with many subspecies, varieties, and forms. Gaussen (1960) divided the "varieties" of P. sylvestris into seven groups. In a recent monograph of P. sylvestris, Pravdin (1964) distinguished five subspecies based on the variation of the geographical races:

- P. sylvestris L. ssp. sylvestris in western Europe and the European part of U.S.S.R., excluding Crimea and Caucasus.

- P. sylvestris L. ssp. hamata (Steven) Fomin. in Crimea and Caucasus.

- P. sylvestris L. ssp. lapponica Fries. Northern Europe and Asia, north of 62° N.

- P. sylvestris L. ssp. sibirica Ledeb. Distributed between 52° N. and 62° N. in Asia.

- P. sylvestris L. ssp. kulundensis Sukaczew. In the transitional zones to the steppes of U.S.S.R. in Asia, south of 52° N.

According to the comprehensive discussion of P. sylvestris in the Mediterranean region by Mirov (1967, pp. 257-261) and my earlier correspondence with him (Mirov 1965), the Turkish materials of P. sylvestris L. belong to the subspecies hamata (Steven) Fomin which is distributed throughout northern Anatolia from the Russian border in the northeast to the vicinity of Afyon in the west. According to Pravdin's infraspecific classification, P. sylvestris L. ssp. sylvestris does not occur in Turkey while P. sylvestris L. ssp. hamata (Steven) Fomin is represented by several ecotypic varieties and growth forms which need to be studied. The synonyms of this subspecies prevalent in Turkey are P. hamata (Steven) Sosnowsky and P. sosnowskyi Nakai.

Pinus sylvestris L. ssp. hamata (Steven) Fomin is a diploxylon pine with two needles and it belongs to the Sylvestres Loud. subsection of the section Pinus. It reaches a height of 20-30 m., and has reddish yellow bark, hence the Turkish name Sarıçam (= Yellow pine). Its crown is quite variable depending on the nature of branches such as "drooping type," "horizontally branching type," "erectly branching type," "pyramidal" and "compact" types (cf. Eliçin 1971). P. sylvestris ssp. hamata is distinguished from other indigenous pines of Turkey by its resinous buds, twisted needles (2.5-8 cm. long), yellow brown and shiny cones born on short stalks. The apophyses of the cone scales are projecting prominently, forming recurved hooks so characteristic for this pine.

Two causacian varieties of P. sylvestris ssp. hamata seem to be widely distributed along the coastal mountain range of northeastern Anatolia:

a) P. sylvestris L. ssp. hamata (Steven)Fomin var. armena (Koch) Pravdin

(cf. Pravdin 1964, p. 137-138) is depicted in fig. 12, Kasaplıgil No. 3879.

(Syn.: P. armena Koch in Linnaea 22, 297, 1849; Id. Dendrol. 2, 2, 281; Fom. in Monit. Jard. bot. Tbilisi 24, 20-22; Vseukr. A. N. Trudy Fiz. - Mat. Vidd. 11, No. 1, 26; P. sylvestris L. ssp. armena Koch (Fomin 1914); P. caucasica Fischer (1889); P. altissima Ledebour (1889); P. erzerumica Calvert (1858); P. sylvestris latifolia Gordon (1858); P. montana Mill. var. caucasica Medvedjev (1905); P. caucasica N. Busch, Tsennye derevya kavkaza 5 (KEPS) No. 16; P. sylvestris caucasica Hort.; P. sylvestris persica Hort.)

This is a small pine, 7-9 m. in height, with short needles (2.5-3.8 cm. long). The cones are slightly longer than the needles and attached to the stem with a short, stout peduncle. The surfaces of the apophyses are glossy, as if they had been varnished, and milk-coffee in color. Hook-like projections of the apophyses are prominent. The seeds are 5 mm. long with a tan colored wing 2-2.5 times longer than the seed. The secondary wood of the specimens I collected from the vicinity of Artvin was white. The needle anatomy is quite different from the next variety (var. kochiana) which seems to be a useful criterion for distinguishing the sterile specimens.

As seen in the cross-section (Fig. 12B), the epidermis is well-demarcated with a thick cuticle layer. The hypodermis is uniform, biseriate along the leaf margins and uniseriate on the dorsal and ventral sides of the leaf. The inner tangential walls of the hypodermal cells are thicker than the outer tangential walls. The mesophyll consists of three layers of chlorenchyma on the adaxial and abaxial sides of the leaf, but 4-5 layers occupy the spaces between the endodermal layer and needle margins. 8-11 resin canals are external in position. The epithelial cells are extremely thin-walled and flattened. The sheaths of sclerenchyma fibers around the resin canals vary between one and two layers and the diameters of the fiber cells are variable as seen in cross sections. The endodermis appears constricted in the middle. The outer walls of the endodermal cells are thicker than their inner walls. The transfusion tissue consists of isodiametric tracheids with relatively thin walls and parenchyma cells with thick walls. The transfusion sclerenchyma forms a massive tissue of very thick-walled cells interconnecting the two vascular bundles (compare the diagrams of the needle sections of two varieties). The vascular bundles are intersected by medullary rays extending continuously through the phloem and xylem tissues of each bundle.

In Komarov's (1934) Flora of U.S.S.R., this variety is treated as an independent species, P. armena Koch distributed in the Caucasus and Transcaucasus extending to Ardahan, Kars, Artvin and Oltu in eastern Turkey. Takhtajan (1954) in his Flora Armenii conbines this variety with Pinus kochiana Klotzsch.

His line drawing (vol. I: 82-87. plate 26) is very similar to my specimen (Kasaplıgil No. 3879) depicted in Fig. 12A, except that the cone is slightly rounded at the apex, appearing ovate in outline. I agree with Pravdin's (1964) treatment of it as a climatic ecotype of P. sylvestris L. ssp. hamata (Steven)Fomin. The extent of its distribution in Turkey deserves further study.

b) P. sylvestris L. ssp. hamata (Steven)Fomin var. kochiana (Klotsch)Fomin (cf. Pravdin 1964, p. 137) is depicted in Fig. 13, Kasaplıgil No. 3880. (Syn. P. kochiana Klotsch in Linnaea 22, 296, 1848).

This is a small, bushy pine with an irregular stem-formation, ascending branches and variable crown. The needles are bluish green 3.5-5 (2-8) cm. long and much wider than the needles of var. armena (see the diagram of the needle cross-section). As an average, the cones are 4-6 cm. long and they are usually shorter than the needles. The apophyses of the ovuliferous scales are gray with a glossy lacquer on their surfaces. The apophyses project prominently forming pyramidal extensions recurved like hooks. The seeds are 5-6 mm. long with slender wings three times longer than the body of the seeds. The secondary stem wood of the specimens I collected from the same locality near Artvin was yellow in color.

The needle anatomy of P. sylvestris L. ssp. hamata (Steven) Fomin var. kochiana (Klotsch)Fomin differs from that of var. armena (Koch)Pravdin in several ways. The cuticle is much thicker while the substomatal cavities are half as large as those in var. armena. The hypodermis is biseriate along the very margins of the needles, uniseriate elsewhere. The inner tangential walls of the hypodermal cells are much thicker than those of var. armena. The mesophyll consists of an outer layer of armed palisade cells with occasional internal ridges, followed by three layers of parenchyma cells with prominent invaginations. 9-10 resin canals are in external position. Thin walled epithelial cells were distorted during sectioning. The sheath of fibers is mostly one-layered, rarely two-layered. Unlike var. armena, the outermost layer of transfusion tissue of var. kochiana consists of tanniferous parenchyma right beneath the endodermis. The schlerenchyma fibers are two-layered on the abaxial sides of the phloem tissues and only one-layered between the two vascular bundles (see the diagram of the leaf cross-section).

According to Pravdin (1964, p. 137) var. kochiana is distributed in southwestern Transcaucasus, Turkey and in Iran. In Latschasvili's (1970) distribution map, it is evident that Koch's pine follows the Turkish border very closely in Georgia. According to the description given by Gulisashvili and Vasiliev (1961,

p. 147), the needles of Koch's pine are 3.5-5 cm. long while Eliçin (1971) gives the needle length 11.2 (9.3-13.2) cm., which seems to be extremely long for Koch's pine. Most likely, Eliçin's (1970) combination "Pinus sylvestris L. ssp. kochiana (Klotsch) Eliçin" represents another variety of P. sylvestris L. ssp. hamata (Steven)Fomin.

Pinus sylvestris L. sensu lato has many horticultural forms with silvery cones and needles or golden yellow young shoots, dwarf, compact or columnar crowns. It is a highly ornamental tree introduced in many parts of the world. For the nomenclature and description of the ornamental varieties and forms, the readers are referred to the comprehensive listings of Beissner-Fitschen (1930), Den Ouden (1965), and Krüssmann (1972). It grows in a great variety of habitats with a remarkable tolerance to the extremes of climatic conditions. It often occupies sandy soils, loams and calcareous soils. In northern Anatolia, it forms pure stands or grows associated with Pinus nigra ssp. pallasiana and Abies bornmülleriana in the vicinity of Bolu, Kastamonu, and Ayancık, with Fagus orientalis, Abies nordmanniana and Picea orientalis in northeastern Asia Minor. It reaches timberline between 1900-2000 m. above sea level in Zigana dağ, south of Trabzon (Kasaplıgil 1947). According to Karamanoğlu (1976), the vertical range of Pinus sylvestris is between 1400 and 2400 m. in Kars, Sarıkamış, Göle, and Oltu. In the continental climate of interior Anatolia, it ranges between the elevations of 1000-2000 m. in isolated groves (Tschermak 1950) where the growth rate is very slow as evidenced by extremely narrow annual rings (Gassner and Christiansen-Weniger 1942).

Pinus sylvestris is an economically important tree yielding valuable wood for construction and carpentry work as well as fuel wood and oleoresin products. It is often used for afforestations, sand fixation and park plantations.

The ancestors of Pinus sylvestris and P. nigra were widely distributed in Europe and Eurasia since the Oligocene, and natural hybrids between the two taxa could have occurred over a long period of time. Artificial hybrids between these taxa have been reported by Duffield (1952). Marginal resin ducts in Pinus sylvestris needles are characteristic for this species while the resin ducts of P. nigra are typically parenchymatous. The occurrence of partly parenchymatous resin canals in the needles of certain populations of P. sylvestris might represent the genetic influence of P. nigra especially in the areas where individuals of these two taxa commingle, as in Anatolia.

During the Ice Age, P. sylvestris retreated from the glaciated areas but survived in the refuges of unglaciated areas of Scandinavia, Scotland, Caucasus, and northeastern Anatolia. However, it was a pioneer invader, especially in the early Holocene when the climate became warmer and P. sylvestris occupied enormous areas as the glaciation retreated. A brief summary of the fossil occurrences of P. sylvestris and related taxa are given below although no Turkish records are presently available.

Fossil records of P. sylvestris L. sensu lata and related taxa. (After Gaussen 1960, Pravdin 1964, Kolakovsky 1965, and Mirov 1967)

Fossil taxa	Age	Locality
Pinus hamata Sosn.	Post-Pliocene	Georgia, U.S.S.R.
Pinus kochiana Klotzsh fossilis	Pliocene	Kodor River, Georgia, U.S.S.R.
Pinus parvula Sap.	Oligocene	Shales of Aix, France.
Pinus sylvestris L.	Lower Pliocene	Northern Croatia, Yugoslavia
Pinus sylvestris L.	Tertiary	Kiev, Ukraine
Pinus sylvestris L.	Pliocene	Frankfurt am Main, West Germany
Pinus sylvestris L.	Upper Tertiary	Portugal
Pinus sylvestris L.	Middle Tertiary	Baltic and Western Siberia
Pinus sylvestris L.	Pleistocene	Sweden, France, Switzerland
P. sylvestris pliocenica Kink.	Pliocene	Lower main Valley, West Germany

I predict that future excavations in the Tertiary deposit sites of central and western Anatolia would yield several new records to this list.

II. The fossil pines of Turkey from the Tertiary deposits of Güvem locality near Ankara.

A) Geological remarks:

The fossil specimens of pines were collected from Güvem subdistrict of Kızılcahamam about 90 km. north of Ankara (see the maps in Fig. 15) during several visits since 1968. The vegetative parts such as long and spur shoots with needles and reproductive parts such as ovulate strobili and seeds occur as impressions in lacustrine diatomites. During the summer of 1976, excavations with Dr. Daniel I. Axelrod and Mrs. Esin Gündüzhan, at different collecting sites along the Gürcü Valley, yielded fine specimens. Additional pine fossils from this locality were loaned to the author by the Museum of Natural History of the Mineral Research and Exploration Institute of Turkey (Maden Tetkik ve Arama Enstitütüsü is abbreviated as "M.T.A.."). Mr. Hicri Aksoy who accompanied me during my initial collections in the summer of 1968 made further collections in subsequent years and made them available for my studies. This work could not have been accomplished without the generous assistance of the Turkish colleagues both in academic and administrative institutions of the country.

The absolute age determinations of the fossil deposit sites were carried out by Teledyne Isotopes in Westwood, New Jersey by Potassium/Argon analysis of three isotope samples selected in the field by Dr. Axelrod. The report of Teledyne Isotopes regarding K/Ar age determination is summarized below:

Rock Sample	Isotopic Age (m.y.)	scc $Ar^{40}Rad/gm \times 10^{-5}$	% $Ar^{40}Rad$	%K
(A) Andesite tuff	14.1 ± 1	.262	55.4	4.37
		.236	43.2	4.39
(B) Rhyolite tuff	11.0 ± 1	.140	38.7	3.05
		.131	21.1	3.07
(C) Welded tuff	11.0 ± 1	.106	22.8	2.29
		.097	14.8	2.27

All samples are done in duplicate and biotite contained in the samples were the basis of determinations. The constants for the age calculation are $\lambda = 4.72 \times 10^{-10} yr^{-1}$, $\lambda_\varepsilon = 0.58 \times 10^{-10} yr^{-1}$ and $K^{40} = 1.19 \times 10^{-4}$ atom percent of natural potassium. Sample (A) andesite tuff was obtained from the Karga Creek site (Alt. ca. 1200 m.) which is the main source of the coniferous impressions. Therefore, these 14.1 ± m.y. old deposits belong to the upper Miocene and not to the Pliocene as reported earlier (Kasaplıgil 1975, 1977). Sample (B) Rhyolite tuff was obtained from the locality above Yukarı Çanlı Village from a land profile along the main road to Çerkeş at an altitude of 1350 m. (see the sketch map). A massif andesitic hill on the western side of the main road of Yukarı Çanlı seems to represent more recent volcanic activity, with continuous release of hot steam along the fault at the summit of the hill. This andesitic massif is situated only 10 km. north of Seyhamam which serves as a health spa with its well known hot springs. Specimen (C) welded tuff was obtained from a locality near Kiliseköy which is also approximately 1350 m. above sea level.

Rhyolite tuff and welded tuff of these two localities are 11.0 ± 1 m.y. old.

According to the Geological Map of Turkey by C. Erentöz (1966), continental Neogene formations of the Güvem subdistrict are bordered by volcanic rocks, basic and ultrabasic intrusives. Erentöz (1975) points out that the general lithology of Central Anatolia comprises "lacustrine limestones, marls, clay tuffs and coarse clastic sediments with widespread horizontal extensions. These facies show some regional changes and have lagoonal, terrestrial and lacustrine characteristics." The regression of the Tethyan sea took place during the Oligocene and the main outline of the Black Sea coast was well defined with minor changes during the Miocene while eastern Anatolia remained under the sea. According to Brinkman (1976), the majority of Central Anatolia was a dry land and the vicinity of Ankara and Konya was a savanna during the late Miocene time. Brinkman's statement may be true for the southern sector of Central Anatolia, but the northern sector of the region was occupied by freshwater bodies of a great variety of sizes, and one of them was a freshwater lake which occupied the Gürcü valley extending from Güvem subdistrict to the foothills of Işıkdağ north of Kızılcahamam. As the tertiary period advanced, the sea of Tethys shrank further as the mountains continued to rise from southern Europe through the chains of the Balkan peninsula, Asia Minor, Caucasus and further east (cf. Brinkman 1959). During the Tertiary period, plant and animal life in Anatolia was similar to that in Europe, but the regression of the sea in the eastern part of the peninsula opened the migration routes from Central Asia to Anatolia, allowing the penetration of Irano-Turanian elements of the flora into eastern Anatolia (cf. Davis 1971). Further regression and desiccation of the Mediterranean Sea during Miocene (Hsü 1978) established the route for floristic affinities between Central Europe and Asia through Anatolia along the southern shores of the Parathethys Sea.

As evidenced by the abundance of fresh water forms of diatomaceous frustules, impressions of cyprinid fish, frogs, salamanders and several genera of aquatic angiosperms, the sediments of the Gürcü valley represent the bottom of a freshwater body. Presently, I do not know the exact boundaries of this lake since further geological surveys are required, along with the exploration of additional fossil deposits, to establish new correlations of fossil plants and animals in the northern sector of Central Anatolia. At any rate, this Miocene lake at the locality given was surrounded by a Coniferous - oak forest particularly rich with pines (5 taxa), redwoods (2 taxa), oaks (12 taxa), and many evergreen and deciduous broad-leaved, woody plants, such as _Acer_, _Ailanthus_, _Alnus_, _Arbutas_, _Betula_, _Carpinus_, _Castanea_, _Castanopsis_, _Cercidiphyllum_, _Cercis_, _Cinnamomum_, Comptonia, Diospyros, Fagus, Ficus, Ilex, Liquidamber, Magnolia, Mahonia, Myrica, Neolitsea, Pasania, Persea, Platanus, Populus, Rhododendron, Rosa, Salix, Sapindus, Sophora, Sorbus, Tilia, Ulmus, Vaccinium, Zelkova, and many other genera. Most likely, these genera flourished luxuriantly in a humid-temperate climate until repeated volcanic eruptions devastated the area with enormous volcanic ash storms.

On a sizzling hot summer day, I found a cool refuge in the shade of an old Black pine (Pinus nigra ssp. pallasiana) about 500 meters east of the Kerimler village. The mighty tree with its crown spreading over the village cemetery, is located at the top of a hill overlooking the desolate slopes of the Gürcü Valley. The cemetery was fenced in with barbed wire to exclude grazing animals, and those traveling to the villages, from entering. So far, I have not found any fossil remains of the Black pine, nor the remains of its ancestral forms. It must be a newcomer to the area.

About 15 million years ago the whole basin was the homeland of a lush green mixed coniferous forest with mighty Redwoods (Sequoia langsdorfii), deciduous swamp cypresses (Glyptostrobus europaeus), spruces, junipers, true cedars, white and yellow pines mixed with the broad-leaved angiosperms mentioned above. It must have been quite a dense woodland, hard to penetrate with woody lianas such as Smilax spp. Hedera, Menispermum and grape vines intertwining the tree trunks. It must have been a woodland of tranquility along the shores of the ancient lake, with bees, wasps, dragon flies and mosquitos buzzing around the cattails and reeds bordering the shallow waters.

All of a sudden, the whole land started to shake with enormous volcanic eruptions. Glowing lava, flowing down the hills set violent fires, and the blowing storms of volcanic ash broke the cones, branches, leaves, acorns and flowers, and scattered them over the lake. Hot volcanic debris settling on the lake and the fiery blobs of lava slipping into the shallow shores brought steamy temperatures which killed all forms of aquatic life instantly. Fishes and amphibians, insects and diatoms, cones, seeds and leaves settled to the lake bottom and quickly sandwiched between silt, volcanic ash and diatom sediments, layers upon layers. The volcanic eruptions must have been followed by torrents of rain, which carried leaves, needles, cones, seeds, flowers and pollen grains from the surrounding hills and all these remains also sunk to the lake bottom, after being soaked in hot waters. Partly broken and fragmented plant remains suggest long distance transportation. Saturated cone scales were closed so that the impressions of the cones appear almost intact. Unfortunately, most of the organic material decayed completely and no compressions were found suitable for cuticular studies. However, the leaf impressions have sufficient detail in their venation patterns, useful for their identification.

Through the subsequent millenia, volcanic activities continued, new eruptions spread additional debris and lava flows over the silt. By resolution of ground water, diatom sediments were transformed into chert, very similar to obsidian. Alternating layers of sedimentation in cherts are beige, grey,, brown or black in color and the plant fossils are well preserved although the animal remains were destroyed completely. Hunting leaf fossils in chert deposits (marked on the sketch map of the Güvem basin) was a painful operation, since every one in the collecting party developed slashed fingers while breaking the flint-like stones, with their razor sharp edges.

Additional floods caused by streams flowing into the Güvem basin brought again a great variety of leaves, pollen grains, and fine silt, and deposited additional layers which were cemented with minerals dissolved in water, forming grey-colored paper shales. Tree trunks buried under sedimentation were petrified by the mineral deposits of percolating waters. These silicified wood samples are kept in the Museum of Natural History of the Mineral Research and Exploration Institute in Ankara. Likewise, all holotypes and hypotypes mentioned in this paper will be deposited in the same museum, while the replicas of the holotypes prepared with silicon rubber, counterparts, and some of the paratypes will be deposited in the Museum of Paleontology of the University of California at Berkeley.

B. Descriptions of the new taxa:

1) *Pinus canariensis* Smith ssp. *meteaensis* n. ssp. (Figs. 23, 26-29)

Ref. to *P. canariensis* Smith in Buch, Phys. Beschr. Canarins. 159, 1825.

Diagnosis: Ovulate cone 15.2 cm. long and 5 cm. wide; ovuliferous scales exposed at cone base 3 - 3.5 cm.long, 1.5 - 1.8 cm. broad at apophyses, sclerenchyma fibers on dorsal surface of scales forming conspicuous ridges radiating from scale base towards apophyses, bracts not evident at base; apophyses at cone center 12 - 18 mm. broad, 9 - 12 mm. high, umbos supra median marked with horizontal keels on both sides; spurs more or less pyramidal terminating into a dull apex, diamond shaped at the base, radial striations absent on surface of apophyses.

Discussion: A single cone impression of this new subspecies is beautifully preserved in diatomite with remarkable detail. A silicon rubber replica I prepared did not cause any damage to the actual specimen during the process of peeling the latex replica. This way, I had the advantage of examining the cone specimen from the outside rather than observing from the inside out. The ovulate cones of the extant P. canariensis ssp. canariensis are very variable in size and structure. It is a subtropical pine endemic to the Canaries. According to Ceballos and Ortuno (1951), it grows between the elevations of 1200 m. and 2400 m. in Tenerife. It is cultivated extensively in the Mediterranean countries and in warmer parts of California. The cones of the cultivated trees vary from 15 to 23 cm. in length while the herbarium specimens I examined do not exceed 18 cm. The outline of the ovulate cone in P. c. ssp. canariensis is broad at the base, tapering towards the apex (cf. Kasapligil No. 4882 in Fig. 24). The umbos are conical, sharply defined, infra median at the cone base and median in the upper parts. Apophyses are characterized by conspicuous striations radiating from the umbos. Lateral, adaxial and abaxial views of the cone scales from the extant species are depicted in Fig. 25.

Unfortunately, I did not find any twig with the needles attached to it. However the twig impression (Kasapligil No. 5617) representing the older growth below and younger growth above is referable to P. c. ssp. meteaensis. The base of the bracts is decurrent, 6-10 mm. long and 1-2 mm. broad. The tips of the bracts are adpressed or free and divergent. The branch fragment is 9.5 cm. long and 0.6 cm. wide (Fig. 26).

Pinus canariensis is a three needle pine, characterized by long, slender and drooping needles with persistent sheath around the spur shoots. Individual leaves or needle fragments are abundant in the fossil deposits, but I could not find a complete spur shoot with complete needles. The incomplete three needles attached to a spur shoot and covered by persistent sheath (Kasapligil No. 5380) are referable to P. c. ssp. meteaensis. This impression in volcanic ash has three slender needles diverging from each other beyond the persistent sheath which is 0.6 cm. long. Other two specimens of three incomplete needles found in paper shale (PA-312, B.K. #6075) and in laminated diatomite (B.K. #5559A) are also referable to P. c. ssp. meteaensis, assuming the convergence of three needles at their bases (Fig. 27, 29). These needles are 1 mm. wide, but I do not know their length since I have no complete set of fossil leaves. Fossil pollen grains identical to those of the extant species are abundant in the substrate.

Affinities: The closest living relative of P. canariensis Sm. is P. roxburghii Sargent (syn.: P. longifolia Roxburgh) which is a native of the Himalayan region extending from northern Pakistan through northern India, Nepal, Sikkim to Bhutan, more than 8000 km. away from the Canaries. The apophyses of the ovuliferous scales of P. roxburghii are conically elongated and reflexed unlike those of P. canariensis. These two species of pines, of course including P. c. ssp. meteaensis belong to the subsection Canarienses Loud. of the section Pinea Endl. of the subgenus Pinus.

Earlier fossil records of P. canariensis were reported from several localities in southern Europe. According to Wulff (1943), a fossil specimen discovered in Malaga, Spain is quite similar to P. canariensis. Likewise, P. o'donelli Teixeira, described from the Miocene epoch of Portugal, and P. ramesiana Sap., described from the Pliocene in Chambeuil, Cantal, France are closely related to P. canariensis. More recently, the cone remains related to P. canariensis from the Pliocene flora of the Kodor River near Sukhumi (Caucasus), were discovered by Kolakovsky (1964, 1965). From these data, it is reasonable to assume that ancestral forms of P. canariensis had a continuous distribution from the Canaries through the northern shores of the Tethys sea (Portugal - Spain - France) and through the southern shores of the Paratethys (Yugoslavia, Bulgaria, Anatolia, southern Caucasus and eastward) during the Middle Miocene (cf. Fig. 2, Paleogeographic map by Hsü et al. 1977).

Occurrence: Upper Miocene 14 ± 1 million yrs. old; Ankara Province, Kizilcanamam district, Guvem subdistrict; Karga Creek site, ca. 750 m. southeast of Demirciler Village, Alt. ca. 1200 m. above sea level, impressions in laminated diatomite, collected in 1975. Holotype: M.T.A. 75/698, Turkish Museum of Natural History, The Mineral Research and Exploration Institute, Ankara. The replica of the holotype: Univ. of California, Berkeley, Museum of Paleontology, Paleobot.; paratypes: Kasapligil No. 5380, 5617, PA-312/ B.K. 6075 and B.K. 5559A deposited at the Turkish Museum of Natural History in Ankara.

The name of the new taxon: The name of the subspecies is derived from the Turkish abbreviation "metea" (Maden Tetkik ve Arama Enstitüsü or M.T.A. The English translation of the Institute as it appears in their scientific bulletin is: "Mineral Research and Exploration Institute of Turkey." This institute is located in Ankara and it houses the Turkish Museum of Natural History. It is a pleasure to name the new subspecies in honor of the M.T.A., whose staff loaned the specimen to this writer in the summer of 1975.

2) Pinus halepensis Miller ssp. alpanii n. ssp. (Fig. 30)

Reference to P. halepensis Miller, Gard. Dict. 8th ed. Pinus No. 8, 1768.

Diagnosis: Ovulate cone straight, symmetrical, 8.3 cm.. long, 3.1 cm. broad at the lower one third of the cone; peduncle almost straight, 1.5 cm. long and .8 cm. thick, obscurely marked with bract scars on surface; apophyses mainly quadrangular, with rounded upper edges near cone apex, radial striations absent, horizontal ridge prominent; umbos flat, with quadrangular markings resembling halos around them.

Discussion: A single cone impression in diatomite was loaned to me by the Turkish Museum of Natural History of the Mineral Research and Exploration Institute in Ankara. The specimen is well preserved in spite of the complete absence of any organic remains. The contrast photograph as well as the latex replica of the specimen were prepared by Mrs. Yvonne Arremo at the Paleobotany Department of the Swedish Museum of Natural History in Stockholm, while the cones of the extant species of P. halepensis were photographed by the author at the Institute of Forest Genetics of the U.S.D.A. Forestry Service in Placerville,, California. A comparison between the fossil and living cones immediately reveals the fact that the apophyses as well as the umbos of the extant species exhibit pronounced protuberances. . Furthermore, pentagonal apophyses are common in the upper half of the cones while the rounded edges are predominant in the basal portions of the cones. The halos are absent around the umbos. The herbarium specimens examined from the eastern Mediterranean region always have conspicuous striations extending radially from the umbo to the margins of the apophyses. The cones from the North African herbarium material, however, lack the striations, although the umbos are raised above the surface of the apophyses. In spite of these variations, P. halepensis ssp. alpanii differs from the extant material mainly by the presence of diamond-shaped or rounded halos around the umbos and by the absence of striations on the apophyses.

Unfortunately, the spur shoots, needles or seeds of P. halepensis ssp. alpanii are not available at the present, but further excavations in this locality may be fruitful in collecting additional vegetative and reproductive organs of this taxon.

Affinities: The closest living relative of P. halepensis Miller is P. brutia Ten. The fossil taxa related to these two species have been discussed earlier in this paper under the heading of each species.

Occurrence: Upper Miocene, 14 $\pm$ 1 million years old; Ankara Province, Kızılcahamam district, Güvem subdistrict, Karga creek site, about 750 meters south east of Demirciler village, alt. ca. 1200 m. above sea level, impression in laminated diatomite, collected in 1976. Holotype: B. Kasaplıgil No. 5623 ex. M.T.A. 2231, deposited in the Turkish Museum of Natural History, The Mineral Research and Exploration Institute, Ankara. The latex replica of the Holotype: U.C. Berkeley, Museum of Paleontology, Paleobot.

Pinus halepensis ssp. alpanii is named in recognition and appreciation of the generous support received from Dr. Sadrettin Alpan, Director General of the Mineral Research and Exploration Institute (M.T.A.) of Turkey.

3) Pinus nickmirovii n. sp. (Figs. 32 and 33)

Diagnosis: Cones ovoid, 7-8 cm. long, 2.3-2.5 cm. wide, symmetrical, tapering towards apex; peduncle absent; ovuliferous scales 2.5 cm. long and 0.9-1.4 cm. wide, apophyses rhomboidal, flat, slightly swollen at upper edge, but not projecting, sharply defined parallel edges, upper margins near cone apex somewhat rounded, horizontal ridges not projecting, but well demarcated, umbo median, smooth, 3-5 mm. long, 2-3 mm. wide, mutic, striations of apophyses absent or obscurely present.

Discussion: The first specimen of this taxon collected by Mr. Hicri Aksoy from the Beşkonak village of the Güvem subdistrict is a brown impression in diatomite. A second specimen, loaned to me by the Turkish Museum of Natural History (M.T.A., Ankara), was also an impression in diatomite with a considerable amount of dark-colored organic remains in the cone scales. The winged seed impression collected from the Karga Creek site of Demirciler village (Kasaplıgil No. 5403) is referable to this new species. The total length of this seed is 15 mm.; the wing alone is 11 mm. long and 4 mm. wide, resembling the seed of P. massoniana Lamb. described by Uyeki (1927). The wing is broadest in the middle part and slopes towards a rounded tip. The seed is 4 mm. long and 2.5 mm. wide.

Unfortunately, the needle pairs with the spur shoots belonging to this pine have not been discovered. The fragments of individual needles are abundant in Beşkonak and Karga Creek sites, but it is not possible to assign them to the new taxon since the needle impressions are not suitable for cuticular preparations.

Pinus nickmirovii differs from P. massoniana mainly by its longer and sessile cones. The apophyses of P. nickmirovii are flat and smooth with one horizontal ridge only, while the apophyses of the P. massoniana cones I examined are thicker and protruding somewhat from the surface. Furthermore, the apophyses of the herbarium specimens collected from Swangsi province of China (R.C. Ching No. 8486, U.C.) have supra median umbos, mostly elliptical in outline. According to Masters (1904), the umbos of P. massoniana are depressed, but contrary to this condition, the living specimens in the Eddy Arboretum (Institute of Forest Genetics, Placerville, Calif.) exhibit slightly projecting umbos. The specimens from northern China have a vertical ridge below the umbo on the basiscopic half of the apophyses.

Affinities: *P. nickmirovii* n. sp. is a diploxylon pine belonging to subsection *Sylvestres* of the section *Pinus*. Its closest living relative, *P. massoniana* Lambert occupies an enormous area from Honan in northern China to Hongkong in the south. It extends from Szechuan in western China to the shores of the China Sea in the east. Isolated populations of *P. massoniana* recur in North Viet-Nam and on the islands of Hainan and Taiwan. The following east Asian pines have taxonomic affinities to *P. massoniana* Lamb.: *Pinus tabulaeformis* Carr. (Chinese pine), *P. densiflora* Sieb. et Zucc. (Japanese red pine), and *P. thunbergiana* Franco (Japanese black pine). All of these diploxylon pines are classified under the Subsection *Sylvestres* (cf. Critchfield & Little 1966) together with the extant Turkish species *P. nigra* Arnold, *P. halepensis* Mill., *P. brutia* Ten., *P. sylvestris* L. Probably our living *P. nigra* is descended from *P. massoniana*, which possibly migrated from eastern Eurasia to western Eurasia along the northern shores of the Tethys Sea during the upper Cretaceous or early Tertiary. Presently, *P. massoniana* grows extensively in the mixed mesophytic forests of the Lower Yangtze Provinces of China associated with *Acer*, *Alnus*, *Carpinus*, *Castanopsis*, *Fraxinus*, *Ilex*, *Kalopanax*, *Liquidamber*, *Magnolia*, *Pistacia*, *Populus*, *Pterocarya*, *Quercus* (several species), *Tilia*, *Ulmus*, and *Zelkova* (Wang 1961). In southern Anhwei, the accompanying trees are *Acer*, *Magnolia*, *Cladrastis*, *Tilia*, *Staphylea*, *Sorbus*, *Tsuga*, *Fraxinus*, *Symplocos*, *Ilex*, *Quercus* and further west in the vicinity of Hwangshan, the associates are *Platycarya*, *Liquidamber*, *Torreya*, *Morus*, *Pistacia*, *Sassafras*, *Tilia*, *Ulmus*, *Zelkova*, etc. In southern Hunan the main constituents of sclerophyllous forests are evergreen trees such as *Castanopsis*, *Pasania*, *Quercus*, *Magnolia*, *Cinnamomum*, *"Bucklandia"* etc. in dry habitats and deciduous broadleaved trees such as *Acer*, *Betula*, *Fagus*, *Liquidamber*, *Cercis*, *Rhus*, *Tilia*, *Sorbus*, *Carpinus*, *Diospyros* in humid sites under maritime influence (Wang 1961, p. 145). It is very remarkable indeed that the genera listed above are represented in the tertiary flora of Güvem occurring together with *Pinus nickmirovii*. The fossils of *P. massoniana* Lamb. reported by W. Szafer from the Pliocene of Poland may be closely allied to *Pinus nickmirovii*.

Occurrence: Upper Miocene, 14 $\pm$ 1 million years old, Ankara Province, Kızılcahamam district, Güvem subdistrict, Gürcü valley, 1975. Holotype: M.T.A. No. 75-687, in Turkish Museum of Natural History, The Mineral Research and Exploration Institute (M.T.A.), Ankara. Paratype: Kasaplıgil No. 5618 ex Hicri Aksoy, complete cone impression in diatomite collected from the Beşkonak village of Güvem subdistrict from the banks of the main road from Kızılcahamam to Çerkeş and deposited at the Turkish Museum of Natural History, M.T.A., Ankara; Topotype: Kasaplıgil No. 5403 seed impression collected from the Karga Creek site, 750 m. S.E. of Demirciler village of Guvem subdist., also deposited in the

Turkish Museum of Natural History, M.T.A., Ankara.

Pinus nickmirovii is named for Dr. Nicholas T. Mirov of the Univ. of California, Geography Dept. in recognition of his contribution to the chemotaxonomy of the genus Pinus.

4) Pinus pinaster Aiton ssp. mioancyrensis n. ssp. (Figs. 34-36)

Reference to Pinus pinaster Aiton, Hort. Kew. 3:367, 1789.

Diagnosis: Ovulate strobili ovoid-conical, asymmetrical, 11-12 cm. long and 4-5 cm. wide near the base, tapering towards the apex and somewhat curved. Peduncle absent; apophyses of the ovuliferous scales rhomboidal, 12-17 mm. wide, 8-12 mm. thick, projecting but not deflexed, umbos and well-defined keels supramedian, vertical keels absent, radiating striations evident, umbos elliptical or rhombic projecting pyramydally 2-3 mm. above cone surface and terminating into a persistent bristle pointed towards the cone apex.

Discussion: The first cone specimen of this taxon collected by Dr. W. Fry in 1969 is an excellent impression preserved in diatomite with a high content of volcanic ash. A second cone impression representing two thirds of a complete cone was collected from the Karga Creek site in 1976. The latex replicas of these cone impressions were most helpful in observing the external structural details. Pinus pinaster Ait. (syn., P. maritima Poiret), French maritime pine, is a western mediterranean pine ranging from Portugal, Spain, and southern France to northwestern Italy, Corsica, and Sardinia. In north Africa, it extends from Tunisia to Morocco. Since it is widely cultivated along the coasts of the Mediterranean region for sand fixation and afforestation purposes, its exact natural distribution can not be defined with certainty. The distributions given for Dalmatia (cf. Jalas & Suominen 1973, p. 17) and Greece (cf. Dallimore & Jackson 1967) need verification. P. pinaster had a much wider distribution, from north Africa to Ireland and from the Iberian peninsula to Asia Minor during the Tertiary period.

The extant species has several varieties and geographical races which are hard to distinguish from one another. The herbarium materials from natural populations as well as the cultivated materials I examined have projecting cone scales with deflexed apophyses. In addition to transverse keels, they also have a vertical ridge. The transverse keels and the umbos in P. pinaster ssp. pinaster are median or infra median in position. The umbos are sharply pointed or dome-shaped and lack bristles.

A leafy impression with two stout needles attached with a long persistant sheath (Kasaplıgil No. 5489) is referable to P. pinaster ssp. mioancyrensis. Unfortunately, the base of the spur shoot is poorly preserved and the needles are incomplete. These fragmentary needles are 53 mm. long and slightly over 1 mm. thick. The stiff appearance of these two needles is a characteristic feature of the maritime pines in general (Fig. 36).

Affinities: P. pinaster Ait. ssp. mioancyrensis is a diploxylon pine which belongs to the Sylvestres subsection of the Section Pinus. Pin maritime de Corse or Corsican pine is described as an independent species, P. mesogeensis Fieschi et Gaussen, and seems to be quite identical with P. pinaster Ait.. (cf. Gaussen 1960, p. 112 and Fig. 332 on p. 117). According to Schütt (1959), P. pinaster crosses naturally with P. halepensis which indicates the genetic affinity between these two taxa. The fossil relatives of P. pinaster are summarized in the following table:

Fossil records of P. pinaster and the taxa related to it. (After Pilger 1926, Gaussen 1960, Mirov 1967 and Nemejc 1968)

Fossil Taxa	Age	Locality
Pinus fittonii Carr.	Lower Cretaceous	England
Pinus ornata Stern	Pliocene	Northern Bohemia, Czechoslavakia
Pinus oviformis Endl.	Pliocene	Northern Bohemia, Czechoslavakia
Pinus oviformis Endl.	Oligocene & Lower Miocene	Central Europe
Pinus pinaster Sol.	Upper Miocene-Early Pliocene	Coiron, Central France
Pinus pinaster Sol.	Pliocene	Sofia, Bulgaria
Pinus aff. pinaster	Miocene	Rochessauve-aux-Coirons, Ardeche (Rhone Valley) France.
Pinus pinastroides Ung.	Oligocene-Lower Miocene	Central Europe
Pinus plutonis Baily	Miocene	Antrium, Northern Ireland
Pinus praepinaster Teiera	Pliocene	Rio Major, Portugal
Pinus spinosa Herbst	Tertiary	Silesia, Poland

Occurrence: Upper Miocene, 14 ± 1 million years old; Ankara Province, Kızılcahamam district, Güvem Subdistrict, Gurcu Valley, 1968 Holotype: Kasaplıgil No. 6078, PA-312 ex Wayne Fry, in Turkish Museum of Natural History, The Mineral Research and Exploration Institute (M.T.A.), Ankara, the replica of the holotype in Univ. Calif. Museum of Palaeontology, Palaebot. Paratype: Kasaplıgil No. 5530, cone fragment, impression in diatomite, collected from the Karga Creek site, 750 m. south east of Demirciler Village of Güvem subdistrict, alt. Ca. 1200 m., Sept. 4, 1976; deposited in the Turkish Museum of Natural History, M.T.A. Ankara; replica of paratype No. 5530 is stored in U.C. Museum of Palaeontol., Palaeobot. Paratype: Kasaplıgil No. 5489, two needles attached to a spur shoot, Gurcu Valley of Guvem subdistrict, also deposited in the Turkish Museum of Natural History (M.T.A.), Ankara.

The name of this subspecies is derived from Ancyra which was the ancient name of the capital city of Ankara dating back to the 9th century B.C.

5) Pinus firatii n.sp. (Figs. 38-50)

Diagnosis: Cones ovoid or conical, pointing towards apex, 10-14 cm. long (according to restored outline), 3.5-4.5 cm. wide near base, peduncle lacking; ovuliferous scales 60-80 per cone, 2.2-2.6 cm. long, 1.2-1.7 cm. wide, abaxial surfaces ribbed lengthwise with prominant fibro-vascular bundles, apophyses oblique rhomboidal, rounded on lateral sides, 1.2-1.8 cm. wide (transversely), 0.8-1.2 cm. high (vertically); umbos terminal, rhombic or rhomboidal in dorsal view, deflexed, horizontal or pointed towards cone apex in closed condition, rhomboidal and pointed at tip, 3-4.5 mm. wide (transversely) 2-3 mm. high (vertically); striations of apophyses in continuity with dorsal ribs of seed scales, converging near the base of umbos.

Leaves in cluster of five needles, variable in length, ranging from 4 to 9 cm., 1 mm. wide, margins obscurely serrulate, tapering at apex; spur shoots 2 mm. long, with deciduous sheath around; scars of the subtending bracts on stems narrowly rhomboidal, 2.5-3 mm. wide, 0.5-1 mm. thick.

Seed wing adnate to seed, 13-19 mm. long, 4-6 mm. wide, rounded or tapering at apex; seeds 6-7 mm. long, 3-5 mm. wide, seed coat striate.

Discussion: Two cone impressions in diatomite were collected by Mr. H. Aksoy from two different sites of the Gürcü Valley of the Güvem locality. Both impressions have excellent structural characteristics although the very apices and the basal parts of the specimens are missing. These two cones show a remarkable resemblance to the extant species Pinus morrisonicola Hayata, a native of Taiwan (cf. Li, 1963 p. 49 and fig. 9 on p. 50). Apparently both of the cones were fossilized in water, since the cone scales are in a closed position. Again, the replicas of these cones provided me with suitable study material for the structural details of the ovuliferous scales which are similar to the oblong-ovoid scales of P. morrisonicola as described by Li (1963). However, according to Cheng (1930), the ovuliferous scales of P. morrisonicola are elliptical in outline, 3 cm. long and total 40 scales per cone. According to reconstructed cone outlines of P. firatii, the number of seed scales per cone would vary between 60 and 80. The tips of the apophyses in P. firatii are thick and the umbos are sharply pointed, while the apophyses of the P. morrisonicola cones that I studied are thinner and terminate into a rounded umbo. Another cone impression borrowed from the Turkish Museum of Natural History (M.T.A. #75-687), of the same locality, is much larger than the first two specimens and its total length is estimated at 14 cm. This specimen has a small portion of the cone axis exposed at its base, but the peduncle is missing again.

I had the opportunity to study nine different specimens of needle clusters varying considerably in size. The shortest cluster (S. Başaran No. 3B) has four slender needles, one of them incomplete, the remaining three needles are nearly 4 cm. long and all of them are attached to a short shoot without a sheath at the base. Possibly, the fifth needle is missing or remains buried within the substratum. Another fine cluster of five complete needles attached to a spur shoot (S. Başaran # 3B) has the total length of 6.5 cm. Three diatomite impressions with scattered and overlapping dense foliage (Kasaplıgil No. 5619 ex H. Aksoy, Kasaplıgil No. 5621, H. Aksoy and Kasaplıgil No. 5622 ex. H. Aksoy) are all traceable to five needles per cluster and No. 5619 is a particularly good specimen since three long shoots appear with numerous spur shoots attached to them. These foliage specimens were collected from the Beşkonak site of the Gürcü Valley where the holotype (No. 5620) and paratype (No. 5193) cone impressions were discovered. During my 1976 visit to the Karga Creek site, I collected two impressions of 5 needles (Kasaplıgil No. 5520 and No. 5625) converging towards the base, but without the spur shoots. Another specimen (Kasaplıgil No. 5443) from the same locality has a long shoot with spur shoots and needle clusters. Although parts of the leaves were missing, the longest needle measured in this specimen was 9 cm., which indicates that the complete needles may be even longer. Finally, a hardened diatomite shale (Kasaplıgil 5492) collected from the chert deposit site on the main road near the cemetery has an impression of five needles with a spur shoot and two winged pine seeds also referable to P. firatii.

The seeds of P. firatii are similar to those in the description of P. formosana Hayata (a synonym of P. morrisonicola Hayata) by Uyeki (1927, p. 86). The wing size is variable, but the outline of the wing and its terminal position in relation to the seed are constant. Paratype B.K. No. 5626 shows the breakable nature of the wing while the specimen No. 21a of S. Başaran represents an unfertilized seed with a rudimentary ovule at base. Such abortive seeds were common in the herbarium material of P. morrisonicola I examined.

Affinities: Pinus firatii is an haploxylon pine belonging to subgenus Strobus section Strobus and subsection Strobi. Its closest living relative, P. morrisonicola of Kwangtung, Taiwan, and the Hainan islands (Lee 1973) is allied to P. parviflora Sieb. et Zucc.(comprising P. pentaphylla Mayr and P. himekomatsu Miyabe and Kudo) from Japan and with Pinus armandii Franchet; a native of southern China and Taiwan. The oleoresin chemistry of the latter species is quite similar to that of P. morrisonicola, suggesting genetic affinity (Mirov 1967). Although P. morrisonicola is included under P. parviflora by Shaw (1914), the latter differs strickingly from P. morrisonicola as well as from P. firatii by its concave umbos and broadly rounded wings, embracing the external margins of the seeds (cf. Uyeki 1927, plate 8, fig. C.). According to Wang (1961), P. morrisonicola Hay. grows in the evergreen broadleaved forests of Hainan together with Quercus, Castanopsis, Pasania, Magnolia, Cinnamomum, Rhododendron, Bucklandia, Engelhardtia, etc. all of which are the familiar genera of the Tertiary floras. Therefore, this author believes that P. morrisonicola Hayata is a Tertiary relict species with limited distribution in eastern Asia some 9000 km. east of the fossil beds of Güvem where the remains of P. firatii were collected.

The fossil relatives of Pinus firatii are summarized in the following table (after Pilger 1926, Miki 1957, MacGinitie 1953, Gaussen 1960, and Kolakowsky 1965).

Fossil Taxa	Age	Locality
Pinus echinostrobus Sap.	Miocene	Armisan, Aude, France
P. geanthracis (Goepp.) E. Reichenb.	Tertiary	Western Georgia, USSR
P. geanthracis (Goepp.) E. Reichenb.	Eocene	Silesia, Poland
P. hordacea (Rossm.) Engelh.	Tertiary	Western Georgia, USSR

Fossil Taxa	Age	Locality
P. hungarica Kov.	Upper Miocene	Northern mountain regions of Hungary.
P. monticola D. Don	Post Pliocene	Omoloi, Arctic Siberia, U.S.S.R.
P. palaeopentaphylla Tanai & Onoe	Mio-Pliocene	Ningyo-Toge between Tortori & Okayama prefectures, Japan.
P. palaeostrobus (Ettingsh.) Heer	Miocene	Zemplon Mts., N.E.. Hungary.
P. palaeostrobus (Ettingsh.) Heer	Miocene	Soma locality, Manisa and Sekbanbeli locality, Tavşanlı, Kütahya, Turkey
P. palaeostrobus (Ettingsh.) Heer	Eocene	Austria
P. palaeostrobus (Ettingsh.) Heer	Paleogene	Greenland
P. palaeostrobus (Ettingsh.) Heer	Oligocene	Middle Dnieper, Tim, U.S.S.R.
P. palaeostroboides Sism.	Miocene	Guarene, Piedmont, N.W. Italy
P. parviflora Sieb. et Zucc.	Pliocene to Pleistocene	16 localities from Japan (Miki 1957, p.247)
P. reussii Corda	Lower Cretaceous	Czenezic, Bohemia, Czechoslovakia
P. strobiformis Bolkhov.	Cretaceous	Moscow Province, USSR
P. strobus L.	Pliocene	Frankfurt am Main, West Germany
P. strobus L.	Pliocene	Romania
P. strobus fossilis Gayl. et Kink	Upper Pliocene	Lower Main Valley, Germany
P. wheeleri Cockerell (aff. P. montivola Douglas)	Oligocene	Florissant beds, near Colorado Springs, Colorado, U.S.A.

Most probably, the needle specimens of P. palaeostrobus (Ettingsh.) Heer at the Turkish Museum of Natural History, which were collected from western Turkey, should be referred to P. firatii. The specimen with four needles on a spur shoot from Tavşanli (M.T.A. No. 61051) possibly lost a needle during fossilization. Further search and collections at the Soma and Tavşanli localities may yield the cone and seed impressions which would bring additional evidence to ascertain the correct identification of the needle clusters.

The pollen grains extracted from diatomite and paper shale rocks from different collecting sites of Güvem locality have been surveyed and photographed. Both psilate and non-psilate types of pine pollens are abundant in the substrata. Since Pinus firatii is the only Haploxylon pine occurring in the Güvem deposits, the non-psilate pollen grains have been referred to Pinus firatii. These pollen grains will be described in a separate article. The dominance of the pine and oak pollens in every slide suggests that both haploxylon and diploxylon pines together with several species of oaks, were the dominant trees of this Tertiary conifer-broadleaved forest..

Occurrence: Upper Miocene, 14 ± 1 million yrs.; Ankara Province, Kızılcahamam District, Güvem subdistrict, Gürcü Valley. Holotype: Kasaplıgil No. 5620 ex. H. Aksoy, ovulate cone impression in diatomite, collected from the Beşkonak site deposited at the Turkish Museum of Natural History (M.T.A.) Ankara; the replica of the holotype in U.C. Palaeontol. Mus., Palaeobot. Paratypes: Kasaplıgil No. 5193 ex. H. Aksoy (cone) and M.T.A. No. 75-687 (cone) deposited in Turkish Museum of Natural History (M.T.A.) Ankara; the replicas in U.C. Palaeont. Mus, Palaeobot. Foliage paratypes: Semra Başaran 3B (two different specimens under the same number) in School of Pharmacy, Univ. of Ankara; Kasaplıgil No. 5619 ex H. Aksoy, 5621 ex H. Aksoy, 5622 ex H. Aksoy (all collected from Beşkonak site) deposited in the Turkish Museum of Natural History (M.T.A.) Ankara and the photographs in U.C. Palaeontology Museum, Palaeobot.; Kasapligil No. 5443, No. 5520, No. 5625 (all from Karga Creek site, 750 m. SE of Demirciler village) deposited in the Turkish Museum of Natural History (M.T.A.) Ankara; Topotype: Kasaplıgil No. 5492 a, Güvem-Çerkeş road, from the chert deposit site below the lone pine near the cemetery, alt. ca. 1150 m., The Turkish Museum of Natural History (M.T.A.) Ankara. Seed Paratypes: Kasaplıgil No. 5626, Karga Creek site, 750 m. S.E. of Demirciler village, alt. ca. 1200 m. in Turkish Museum of Natural History (M.T.A.) Ankara; S. Başaran No. 21 a, abortive seed from the Gürcü Valley, in School of Pharmacy, Univ. of Ankara; topotypes: Kasaplıgil No. 5492 b and c, Güvem-Çerkeş road, below the lone pine, near cemetery, in Turkish Museum of Natural History (M.T.A.) Ankara.

This fossil pine is named in honor of Professor Fehim Fırat of the Forestry College of the University of Istanbul in recognition of his contribution to the management of Pinus pinea L. forests in Turkey.

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Summary and Conclusions:

A review of the extant species of the genus Pinus in Turkey and their fossil representatives in Turkey or elsewhere was necessary for the identification and evaluation of the Miocene pine taxa collected from the Gürcü Valley of Güvem Subdistrict located 90 km. north of Ankara. The living taxa of pines of Turkey are discussed at specific and infraspecific levels. Out of five living pines present in Turkey only two occur in Gürcü valley from Işıkdağ in the north to Güvem in the south: Pinus nigra Arnold ssp. pallasiana (Lamb.) Holmboe and Pinus sylvestris L. ssp. hamata (Steven) Fomin (cf. Figures 1, 15 and 16). Neither one of these pines was present in the miocene forest which occupied the shores of a fresh water lake around the Gürcü Valley area approximately 15 million years ago. Five new taxa of fossil pines have been described and their affinities to the living pines are discussed. Pinus canariensis Sm. ssp..meteaensis n. ssp. is represented by impressions of a seed cone, of a twig without foliage, several leaf impressions and abundant pollen grains in the lacustrine sediments. Its closest relatives are Pinus canariensis Sm. of Canary Islands and Pinus roxburghii Sargent of the Himalayan region. The Canary Island pine is extinct in the Mediterranean basin but the fossil remains of its ancestral forms have been reported from Portugal, Spain, France and Caucasus. Possibly, it had a wider range extending eastward through the southern shores of Paratethys sea during Middle Miocene.

Pinus halepensis Aiton ssp. alpanii n. ssp. is represented by a single cone impression in diatomite. Its closest living relatives are P. halepensis Aiton ssp. halepensis and P. brutia Ten. which are distributed in the coastal regions of Turkey.

Pinus nickmirovii n. sp. is represented by two impressions of seed cones quite similar to the ovulate cones of P. massoniana Lamb., a native of China, Viet Nam and Taiwan.

Pinus pinaster Aiton ssp. mioancyrensis n. ssp. is represented by two cone impressions and two needles attached to a spur shoot. Pinus pinaster is extinct in Asia Minor, but during the Tertiary period, it had an extensive distribution from northern Ireland and England through Central Europe and the Balkan Peninsula to Anatolia.

Pinus firatii n. sp. is the only haploxylon pine of the Upper Miocene flora of the Güvem locality. This pine is represented by impressions of two cones, two seeds, long and spur shoots with clusters of five needles in diatomites. It is closely allied with Pinus morrisonicola Hayata, an extant species native of eastern Asia.

All holotype and paratype specimens of these fossil taxa are deposited in the Turkish Museum of Natural History, Mineral Research and Exploration Institute of Turkey (M.T.A.), Ankara. Silicon rubber replicas of the cone impressions and contrast photographs of the other type materials are deposited in the Paleontology Museum of the University of California, Berkeley.

From the survey of literature, I believe that most of the modern genera of the gymnosperms were differentiated as early as the beginning Eocene epoch of the Tertiary period. The new taxa described from the Upper Miocene of the Güvem flora in this paper are remarkably similar to the extant species. However, due to certain structural differences observed and the ecological changes which occurred during the past fifteen million years, the present author feels justified to apply new names to the Miocene materials described here. Obviously, some of the fossil specimens collected in the field are quite incomplete, lacking vegetative parts and seeds. Discovery of additional materials and of complete specimens with branches with the cones and foliage attached to them or a thorough survey of the allied fossil pines reported from other Tertiary floras of Europe and Asia may reduce some of the proposed names into synonymy. Until then, the nomenclature proposed in this article should serve the purpose of communication.

The occurrence of five different fossil taxa of pines in the Miocene flora of Güvem which occupies a relatively small area is not surprising at all. Martinez (1963) lists ten species of pines for Valle de Mexico, one of the smallest states of Mexico with a total area of 1555 square miles. Seven species of pines grow in the Lake Tahoe Basin (cf. Griffin & Critchfield 1972 and G. L. Smith 1973). It is very likely to discover additional taxa of pines by exploring the other Tertiary fossil deposits in Asia Minor.

Other gymnosperms associated with the Miocene pines of the Guvem locality are: Glyptostrobus, Sequoia, Taxodium, Keteleeria, Picea, Cedrus, Tsuga, Cupressus, Juniperus, Thuja, Libocedrus, Cephalotaxus and Ephedra. The broadleaved trees of this conifer-hardwood forest are represented by twelve species of fossil oaks and many other genera such as Acer, Alnus, Ailanthus, Arbutus, Broussonetia, Betula, Carpinus, Castanea, Castanopsis, Cercidiphyllum, Cercis, Cinnamomum, Crataegus, Diospyros, Fagus, Ficus, Gleditschia, Juglans, Liquidambar, Magnolia, Myrica, Neolitsea, Persea, Platanus, Populus, Salix, Sapindus, Symplocos, Tilia, Ulmus, Zelkova, etc. Several tree genera such as Glyptostrobus, Sequoia, Taxodium, Keteleeria, Tsuga, Thuja, Libocedrus, Cephalotaxus, Broussonetia, Castanopsis, Cerdidiphyllum, Cinnamomum, Magnolia, Myrica, Neolitsea, Persea, Sapindus and Symplocos are extinct in the present flora. However, many other Tertiary genera are well-represented in the relict forest of Hatila Valley near Artvin in northeastern Turkey. This relict forest deserves the immediate attention of the Turkish Forestry Service for a strict preservation as a national park.

Among various fossil collecting sites along the Gürcü Valley of Güvem (see Figure 16), Karga creek site situated 750 meters southeast of Demirciler village is the richest source of the fossil remains. Unfortunately, thousands of fossil specimens in diatomite and paper shale slabs have been sold to the tourists by the children of the neighboring villages or smuggled out of the country by foreign visitors. The Miocene deposits of the Karga Creek area need to be fenced in for immediate protection as a natural monument.

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__________ 1962
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Figure 1:

The distribution of the extant species of pines in Turkey: (1) Pinus brutia Ten., (2) P. halepensis Mill., (3) P. nigra Arn. ssp. pallasiana Holmboe, (4) P. pinea L., (5) P. sylvestris L. (sensu lata). Note that the locality for the Tertiary pines is marked by crossed hammers underneath the word Güvem, north of Ankara.


BULGARIA
GREECE
BLACK
Kirklareli
Edirne
Tekirdağ
Istanbul
Izmit
Zonguldak
Kastamonu
Bolu
Güvem
Ankara
Bursa
Balikesir
Eskişehir
Afyon
Salt Lake
Izmir
Konya
Niğ
Karaman
Muğla
Mersin
Antalya
MEDITERRANEAN SEA

Figure 1


SEA
U.S.S.R.
IRAN
IRAQ
SYRIA
Ordu
Trabzon
Rize
Artvin
Kars
Erzurum
Erzincan
Sivas
Van
Malatya
Tigris
(Dicle N.)
Euphrates (Fırat N.)
G. Antep
Distribution of Pines in Turkey
by B. Kasapligil
0 50 100km.
(1) Pinus brutia Ten.
(2) Pinus halepensis Mill.
(3) Pinus nigra Arn. ssp. pallasiana Holmboe
(4) Pinus pinea L.
(5) Pinus sylvestris L. (s.l.)

Figure 2:

"Patriarch tree" of Pinus brutia var. pityusa in Pitsunda forest reserve between Gudauta and Gagra northwest of Sukhumi, Georgia, U.S.S.R. This specimen is approximately 300 years old. Note the burl formation around the basal portion of the stem.

Figure 3:

Pinus pinea forest in Fıstıklı locality near Artvin in north eastern Anatolia. Typical evergreen shrubs of maquis in foreground and the Çoruh River in the background. This photograph was taken during the summer of 1964. Note that the trees of this stand are more or less equally spaced.

Figure 4:

Pinus pinea L. (Kasaplıgil No. 3878 b, collected from the Fistikli village near Artvin). A: The vegetative branch with needle clusters and recurved bracts; B: The upper portion of a mature cone with prominent apophyses; C: Abaxial view of an ovuliferous scale with two immature seeds. Drawing by Miss Janet Duecy.

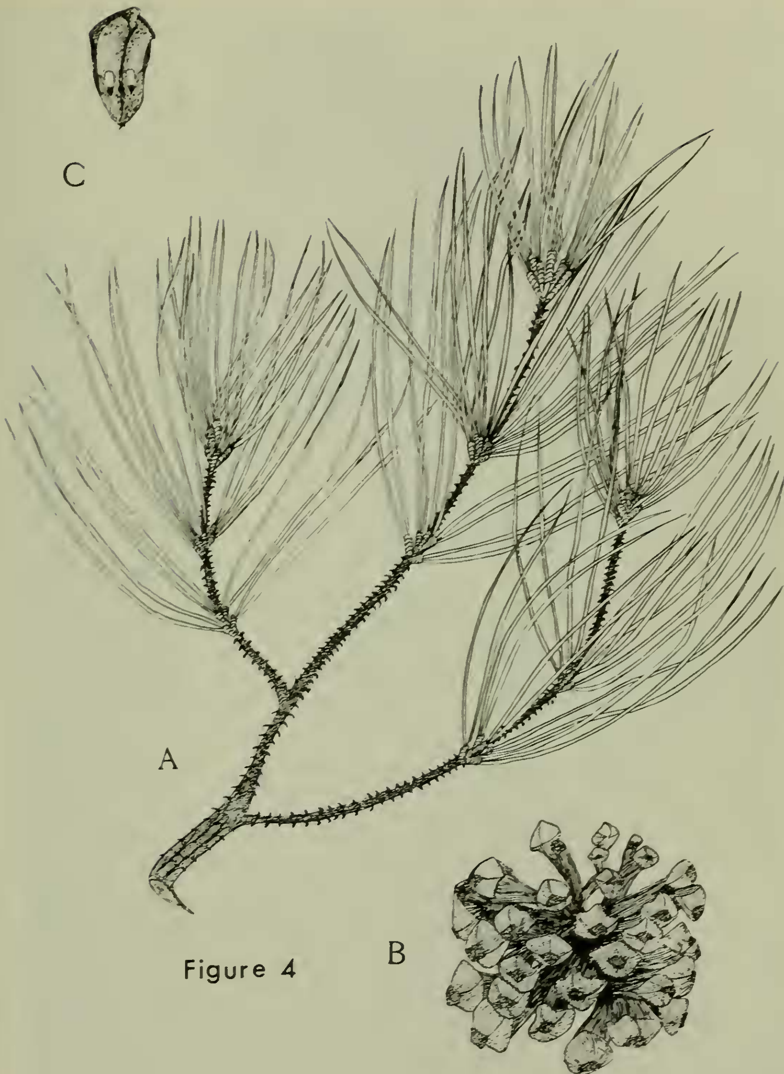

Figure 4

Figure 5:

A fine specimen of *Pinus pinea* L. near Fıstıklı village, about 7 km. west of Artvin, on the way to Hatila Valley. This picture was taken during the summer of 1964 when I visited this locality together with Mr. Orhan Ataman, a senior forestry officer from the Forest District Headquarter in Trabzon. Since then, trees suitable for timber production have been cut by encroachers and dense undergrowth suffered from overgrazing.

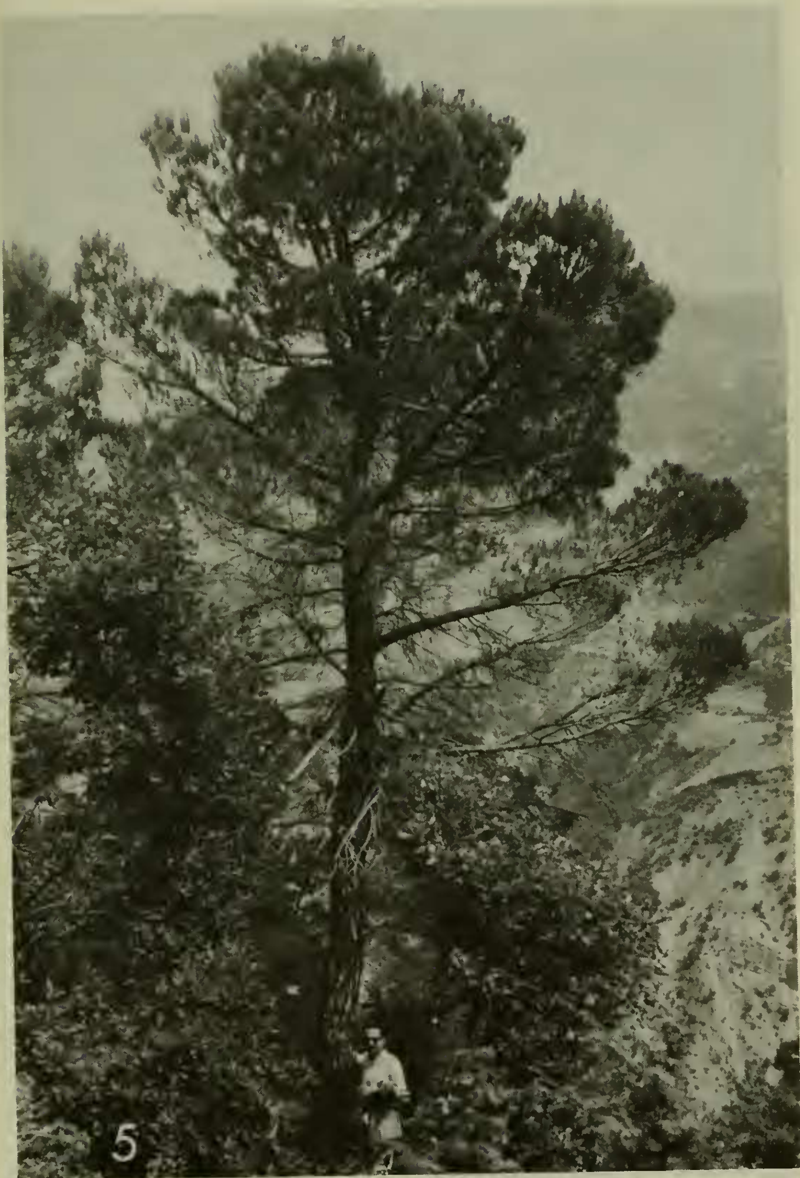
5

Figure 6:

Cultivated specimens of Pinus pinea along the shores of Bosphorus, Istanbul. Due to housing developments and population increase, these decorative trees are disappearing fast.

Figure 7:

A Pinus pinea L. stand near Düzköy Village (formerly Kalanema Village) about 20 km. south of Akçaabat on the Black Sea coast. Scattered stands of the Pinion pine occur between the elevations of 50 m. to 500 m. along the slopes of Söğütlü Dere (formerly Kalanema Valley).

Figure 8:

The Pinion pines growing in maquis along the Mediterranean Coast of Turkey between Aksu and Manavgat near Antalya. This photograph was taken in 1952 before the tourist industry developed in the area. The consequences of human pressure upon this grove deserve investigation.


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7


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Figure 9:

A group of young Pinion pines along the roadside near Yeşiltepe village of Kalanema Valley about 20 km. south of Akçaabat on the Black Sea coast. These trees as well as those in the background are severely mutilated for fuel extraction.

Figure 10:

A Pinion pine at Fıstıklı locality near Artvin showing the constriction of the stem base through girdling of a lateral root. This sample tree was 83 years old and its base is exposed by erosion on this steep slope about 600 m. above sea level.

Figure 11:

Core sampling of a *Pinion pine* in Yeşiltepe village of Kalanema Valley by Mr. Hasret Atasoy, a forestry engineer who is a native of this valley. This specimen growing at an altitude of 320 m. was 75 years old. The associated flora had some Mediterranean elements such as *Arbutus andrachne*, *A. unedo*, *Pistacia terebinthus*, *Juniperus oxycedrus*, *Cistus salviifolius* a.s.o.


9


10


11

Figure 12:

Pinus sylvestris L. ssp. *hamata* (Steven)Fomin var. *armena* (Koch) Pravdin. The specimen was collected from a magnificent young tree growing near the upper edge of the Pinion pine forest in Fıstıklı village 7 km. west of Artvin in 1964, Kasaplıgil No. 3879. Unfortunately, these pines are no longer in existence in this locality. A: a branch with a mature seed cone and short needles; B: photomicrograph of the needle cross-section showing epidermis, hypodermis, marginal resin canals, three-layered chlorenchyma, constricted endodermis, two vascular bundles interconnected by transfusion sclerenchyma; C: a mature seed with wing, slightly reduced. Drawing by Miss Janet Duecy.

Figure 12

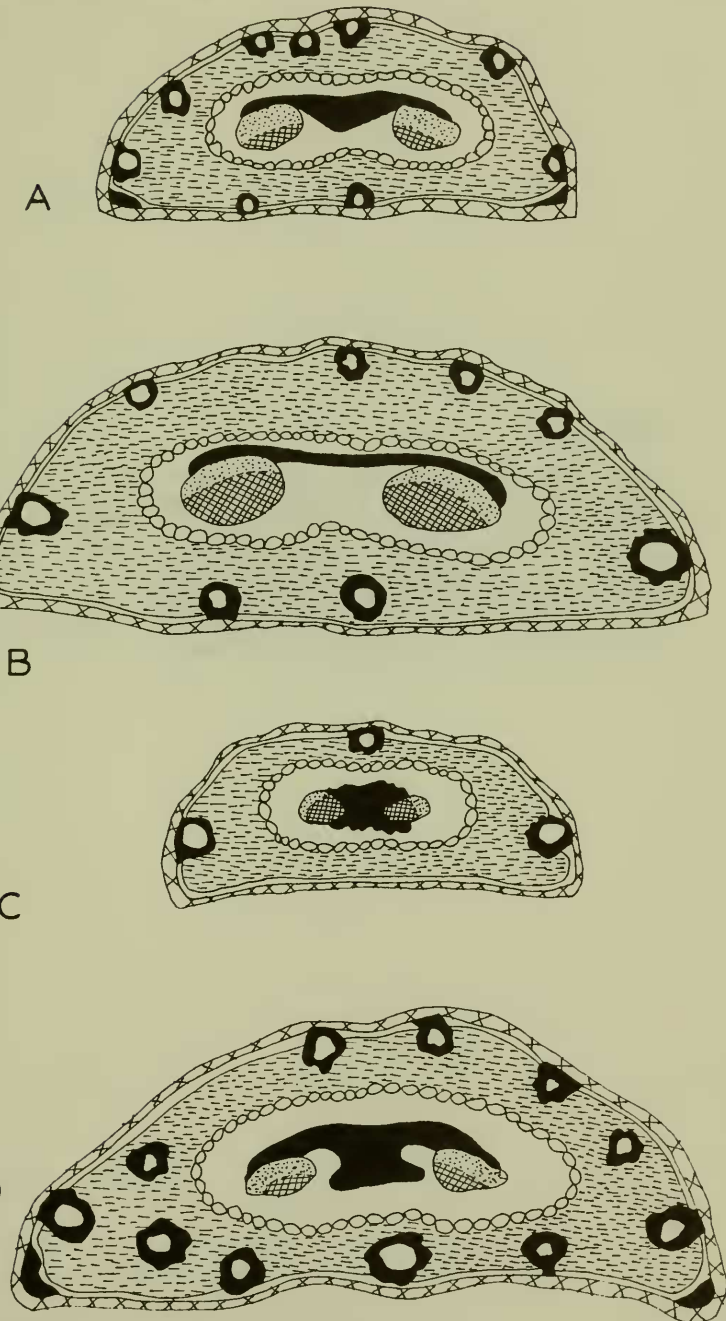
Figure 13:

Pinus sylvestris L. ssp. *hamata* (Steven)Fomin var. *kochiana* (Klotsch) Fomin. A branch with long needles, a mature seed cone and two developing ovulate cones (near the tip of the long shoot). A mature seed with its wing at the lower left corner is slightly reduced. This specimen also was collected (Kasaplıgil No. 3880) from the Fıstıklı locality of Artvin in 1964; again, they are completely eradicated since then. See the text for description and dimensions. Drawing by Miss Janet Duecy.

Figure 13

Figure 14:

Seoscope drawings of needle cross-sections of *Pinus sylvestris* L. Solid black areas represent the sclerenchyma tissues in all drawings. For explanation of anatomical features see the text. A: *Pinus sylvestris* L. ssp. *hamata* (Steven)Fomin var. *armena* (Koch) Pravdin. Artvin, Kasaplıgil No. 3879, U.C.B. Herbarium; B: *Pinus sylvestris* L. ssp. *hamata* (Steven) Fomin var. *kochiana* (Klotsch) Fomin. Artvin, Kasaplıgil No. 3880, U.C.B. Herbarium; C: *Pinus sylvestris* L. forma *parvifolia* Heer from Sweden, Vestrogothia, par Toasp, Tubbared, A. O. Olson, September 8, 1925 (specimen courtesy of Botany Dept., Swedish Museum of Natural History, Stockholm; D: *Pinus sylvestris* L. var. *genuina* (Heer) A. & G. forma *plana* Christ. All drawings are approximately 40X.



14

Figure 15:

The Tertiary pines described in this paper were collected from the Güvem subdistrict (shaded area north of Kızılcahamam) about 90 km. north of Ankara. The map of Turkey at the lower right corner shows the Province of Ankara in relation to Anatolia. (Map courtesy of Professor Necmi Sönmez, Head of the Department of Agricultural Engineering, College of Agriculture of the Üniversity of Ankara).

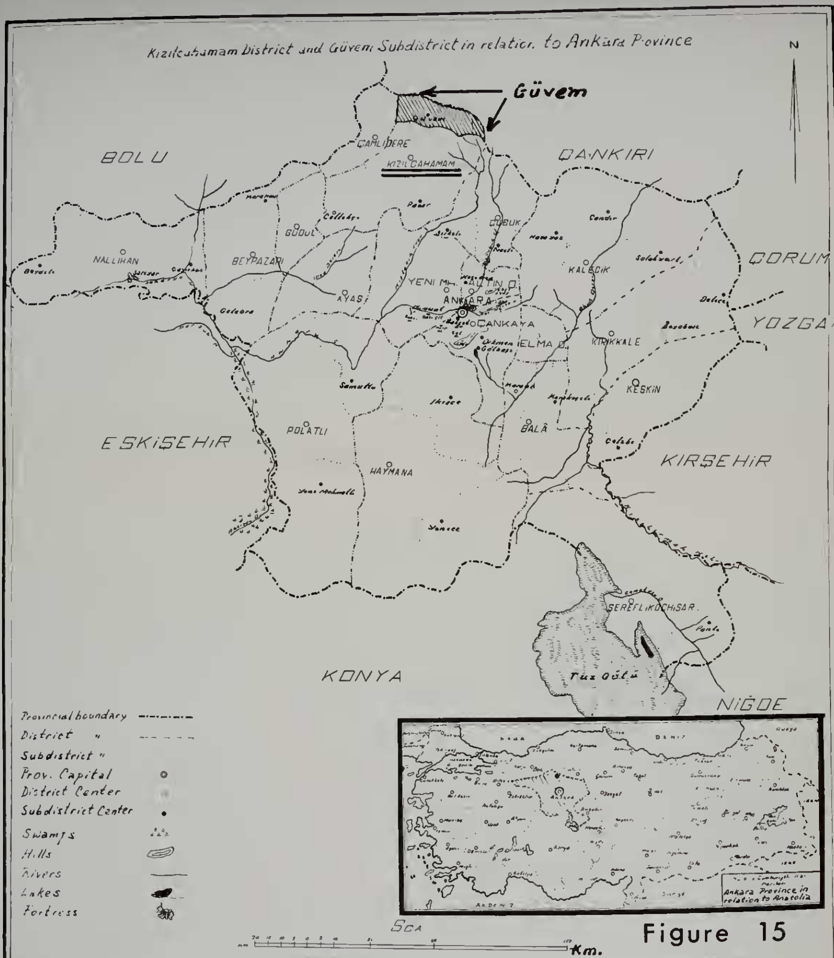

Kızılcahamam District and Güvem Subdistrict in relation to Ankara Province
N
Güvem
BOLU
ÇANKIRI
ÇORUM
YOZGAT
KIRŞEHİR
ESKİŞEHİR
KONYA
NİĞDE
ÇAMLIDERE
KIZILCAHAMAM
ÇUBUK
GÜDÜL
NALLIHAN
BEYPAZARI
AYAS
YENİ MH.
ALTIN D.
ANKARA
ÇANKAYA
ELMA D.
KALECİK
KIRIKKALE
KESKİN
BALÂ
POLATLI
HAYMANA
ŞEREFLİKOÇHİSAR
Tuz Gölü
Provincial boundary
District "
Subdistrict "
Prov. Capital
District Center
Subdistrict Center
Swamps
Hills
Rivers
Lakes
Fortress
Ankara Province in relation to Anatolia
Sca
Km.

Figure 15

Figure 16:

Sketch map of Gürcü Deresi (= Georgian Valley) showing the main road from Kızılcahamam to Çerkeş and the fossil collecting sites marked by crossed hammers and the dates of collections. The earliest collecting site, Beşkonak locality which was visited in 1968 is situated south of Ağaöz (= Aköz) village. Karga Creek site which is the richest source of well-preserved fossil impressions is located 750 meters south east of Demirciler (Bölükbaşı) village. The shaded areas represent the settlements; (A) andesite, (B) Rhyolite tuff and (C) Quarz latite, designate the locations of rock samples used for age determination.

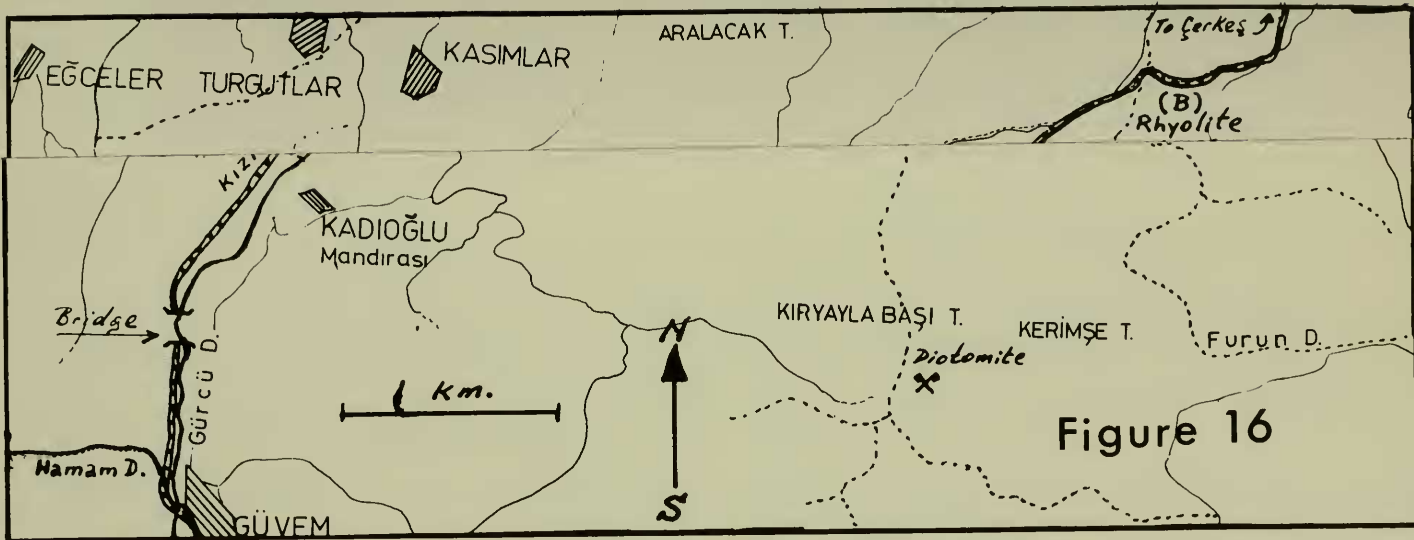
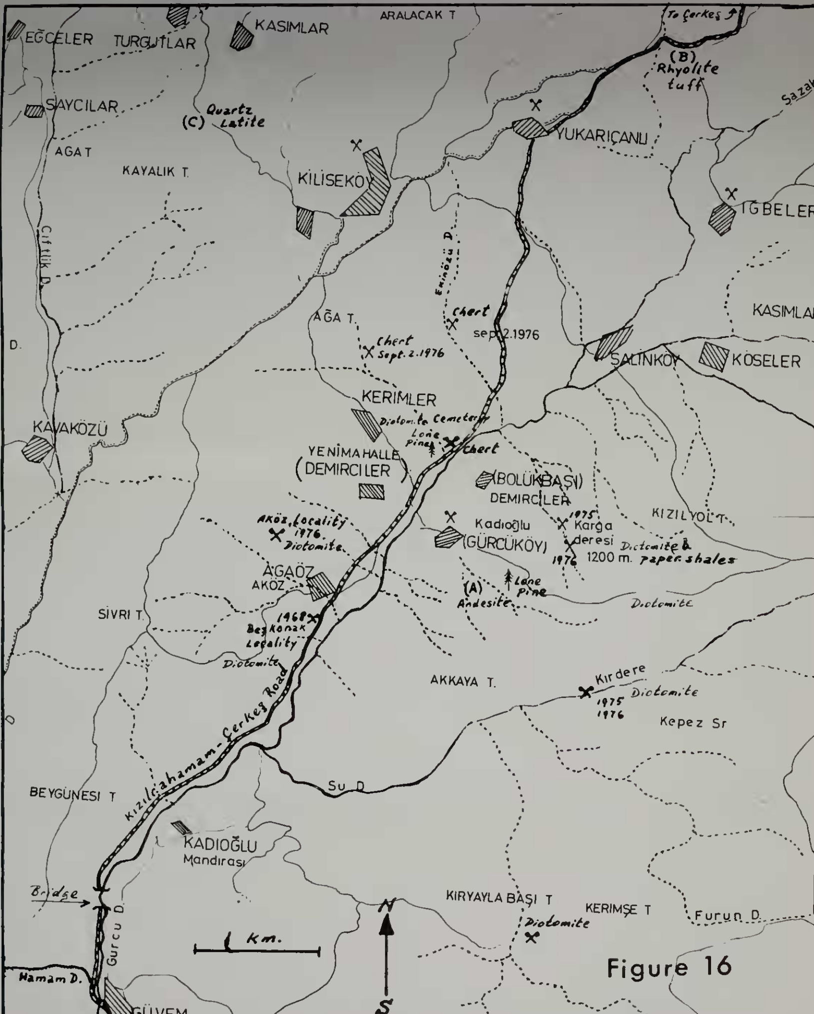

EĞCELER
TURGUTLAR
KASIMLAR
ARALACAK T.
To Çerkeş
(B)
Rhyolite
Kızıl
KADIOĞLU
Mandırası
Bridge
Gürcü D.
Hamam D.
GÜVEM
1 km.
N
S
KIRYAYLA BAŞI T.
KERİMŞE T.
Furun D.
Diotomite

Figure 16



EĞCELER
TURGUTLAR
KASIMLAR
ARALACAK T
To Çerkeş
(B) Rhyolite tuff
Sazak
SAYCILAR
(C) Quartz Latite
YUKARIÇANLI
AGAT
KAYALIK T.
KILISEKÖY
IĞBELER
Çiftlik D.
Eminözü D.
KASIMLAR
AĞA T.
Chert
sept.2.1976
Chert Sept.2.1976
D.
SALINKÖY
KÖSELER
KERIMLER
Diotomite Cemetery
KAVAKÖZÜ
Lone Pine
Chert
YENİMAHALLE
(DEMIRCILER)
(BOLÜKBAŞI)
DEMIRCILER
1975 Karga deresi
1976
1200 m.
Diotomite & paper shales
KIZILYOL T.
Kadıoğlu
(GÜRCÜKÖY)
Aköz Locality 1976. Diotomite
AĞAÖZ
AKÖZ
(A) Andesite
Lone Pine
Diotomite
SIVRI T.
1968 Beşkonak Locality
Diotomite
AKKAYA T.
Kirdere
Diotomite
1975
1976
Kepez Sr
Kızılcahamam-Çerkeş Road
Su D.
BEYGÜNESI T
KADIOĞLU
Mandırası
Bridge
Gurcu D.
KIRYAYLA BAŞI T
KERIMŞE T
Furun D.
Diotomite
N
S
1 Km.
Hamam D.
GÜVEM

Figure 16

Figure 17:

Kadıoğlu (=Gürcüköy) and Demirciler (= Bölükbaşı) villages as seen from the lone pine near Kerimler (compare with the sketch map in Fig. 16). Willows and Lombardy poplars along the stream of Gürcü Valley in foreground, scattered oaks, pines, junipers and wild pears (Pyrus elaeagrifolia) in background. A pile of volcanic rocks is seen on the edge of a grain field at the lower left corner.

Figure 18:

Fossil excavation site in Karga Creek, 750 meters South east of Demirciler Village, altitude ca. 1200 meters above sea level. The steep banks of this creek are the richest source for fossil impressions. The lacustrine deposits were 7 meters high in this particular spot. The trees on the left-hand side are Populus tremula L. and those to the right Quercus pubescens Willd.

Figure 19:

A laminated diatomaceous slab bearing the leaf impression of Acer trilobatum (Sternberg) A. Braun, one of the most abundant maples of the fossil flora and the fertile branchlets of Glyptostrobus europaeus (Brongn.) Heer with scale-like leaves and mature ovulate cones (to the right).

17

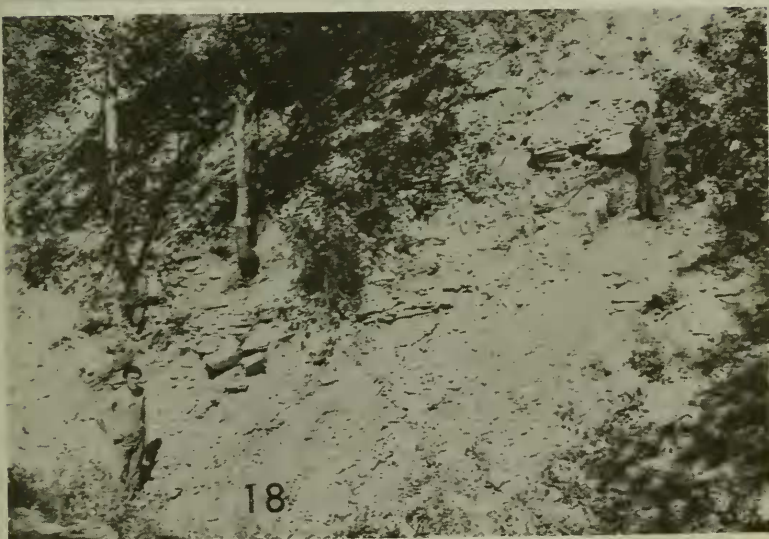


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Figure 20:

Fossil beds along the banks of Karga Creek near Demirciler Village. This important locality needs to be fenced in for proper protection against souvenir hunters. The trees in the upper part of the slope against the sky are *Pinus nigra* Arnold ssp. *pallasiana* (Lamb.) Holmboe.

Figure 21:

The general aspect of Gürcü Valley as seen from the Karga Creek collecting site near Demirciler Village. Aspens, Black pines and oaks in foreground and a gallery forest of willows and poplars along the stream bed of Gürcü Valley in background (marked by an arrow).

Figure 22:

Andesitic boulders on top of a hill near Yukarı Çanli village by Soğuksu locality on the main road to Çerkeş, altitude ca. 1400 m. above sea level. According to the villagers, here it snows every winter covering the woody slopes, but the snow never persists upon the ridge and hot steams shoot out into the sky, which suggests the recency of the volcanic activity in the area. The denuded forest on the slope consists of *Populus tremula* L., *Quercus pubescens* Willd., *Paliurus Spina-Christi* Miller, *Pinus nigra* Arnold ssp. *pallasiana* (Lamb.) Holmboe and *Juniperus communis* L. ssp. *nana* Syme.

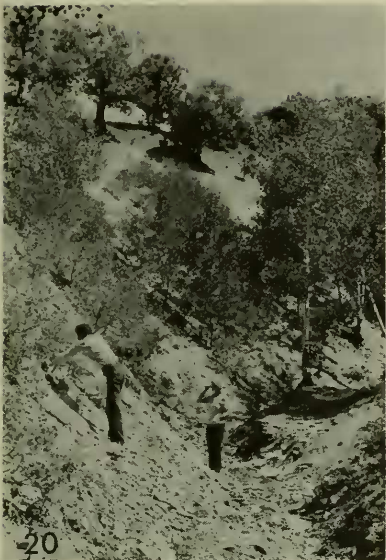


Figure 23:

Pinus canariensis Smith ssp. meteaensis Kasapligil, holotype: M.T.A. 75/698, Turkish Museum of Natural History, The Mineral Research and Exploration Institute, Ankara.

Figure 24:

Pinus canariensis Smith, mature ovulate cone of the extant species, Kasaplıgil No. 4882, collected from the cultivated trees next to the Campanile (Sather tower) of the University of California campus, Berkeley.

23

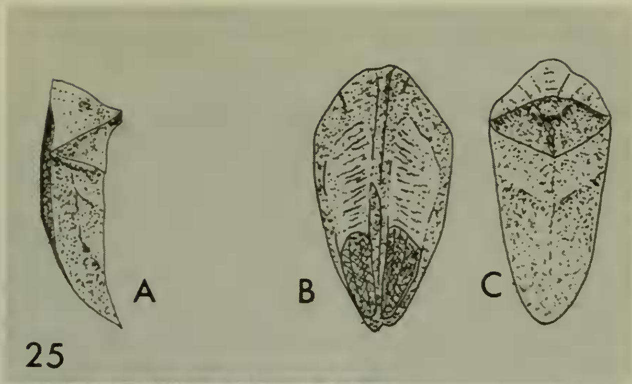
24

Figure 25:

Ovuliferous scales from a mature seed cone of Pinus canariensis Smith. Hermann Knoche No. 590 Febr. 1915-16, Excursion 35, in Dudley Herbarium of Stanford Univ. No. 394 556 (specimen courtesy of California Academy of Sciences, San Francisco). A: Lateral view of the cone scale with prominent apophyses and projecting conical umbo; B: Ventral view of the megasporophyll with two mature seeds, their undulate wings and a ridge between; C: Dorsal view with well defined apophysis and radiating striations. Drawings by Miss Angela vanPatten.

Figure 26:

Pinus canariensis Smith ssp. meteaensis Kasaplıgil. A twig representing the growth of two years. Paratype, Kasaplıgil No. 5617, Turkish Museum of Natural History, M.T.A., Ankara.


A
B
C
25


26

Figure 27:

Pinus canariensis ssp. *meteaensis* Kasapligil. Fragments of three needles. Paratype, U.C., PA-312, Kasapligil No. 6075, Turkish Museum of Natural History, M.T.A., Ankara.

Figure 28:

Pinus canariensis ssp. *meteaensis* Kasapligil. A spur shoot with the basal portions of three needles with a persistent sheath around them. Paratype, Kasapligil No. 4380, Turkish Museum of Natural History, M.T.A., Ankara. (Slightly enlarged, see the text for measurements).

Figure 29:

A: Fragments of three needles referred to *P. canariensis* ssp. *meteaensis* Kasapligil, Paratype, Kasapligil No. 5559 A, Turkish Museum of Natural History, M.T.A., Ankara; B: *Quercus sclerophyllina* Heer; C: *Quercus kubinyi* (Kov.) Czecz.; D: *Quercus seyfriedii* A. Braun.


PA-318
Kasapligil
cm
27


28


D.
C.
A.
B.
No 5559
29

Figure 30:

Pinus halepensis Aiton ssp. alpanii Kasapligil. Holotype: Kasapligil No. 5623 ex M.T.A. 2231, Turkish Museum of Natural History, The Mineral and Exploration Institute, Ankara. Phorograph by Mrs. Yvonne Arremo (Swedish Museum of Natural History, Paleobotany Dept., Stockholm).

Figure 31:

Two mature ovulate cones of Pinus halepensis Aiton. The specimens courtesy of Institute of Forest Genetics, Pacific southwest Forest and Range Experiment Station, Forestry Service, Berkeley, California.


cm 1 2 3 4
30

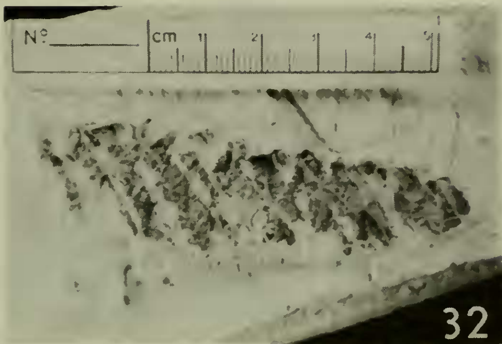

31

Figure 32:

Pinus nickmirovii Kasapligil. Holotype: M.T.A. No. 75-687, in Turkish Museum of Natural History, The Mineral Research and exploration Institute of Turkey (M.T.A.) Ankara.

Figure 33:

Pinus nickmirovii Kasapligil. Paratype: Kasapligil No. 5618 ex Hicri Aksoy, in Turkish Museum of Natural History, M.T.A., Ankara.


N°
cm
32

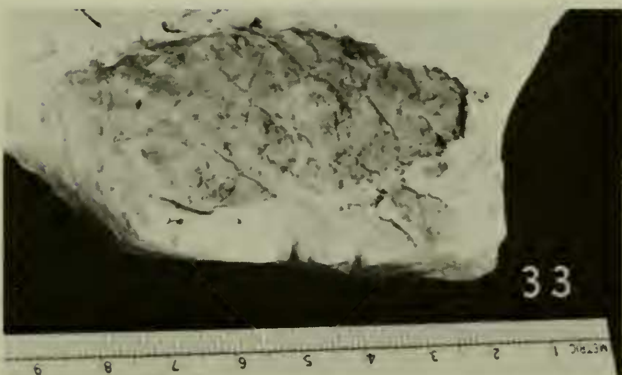

33

Figure 34:

Pinus pinaster Aiton ssp. mioancyrensis Kasapligil. Holotype: Kasapligil No. 6078, ex Wayne Fry, U.C., PA-312.

Figure 35:

Pinus pinaster Aiton ssp. mioancyrensis Kasapligil. Paratype: Kasapligil No. 5530, cone fragment.

Figure 36:

Pinus pinaster Aiton ssp. mioancyrensis Kasapligil. Paratype: Kasapligil No. 5489, two needles attached to the spur shoot.

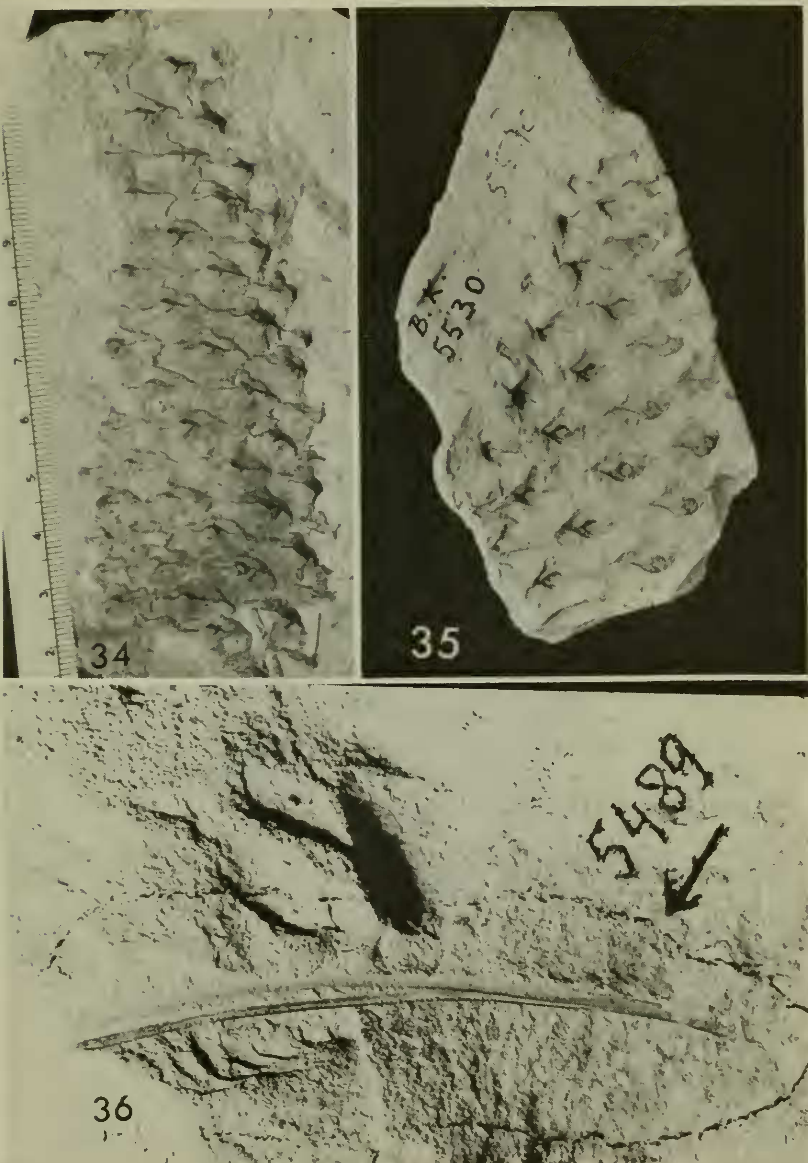
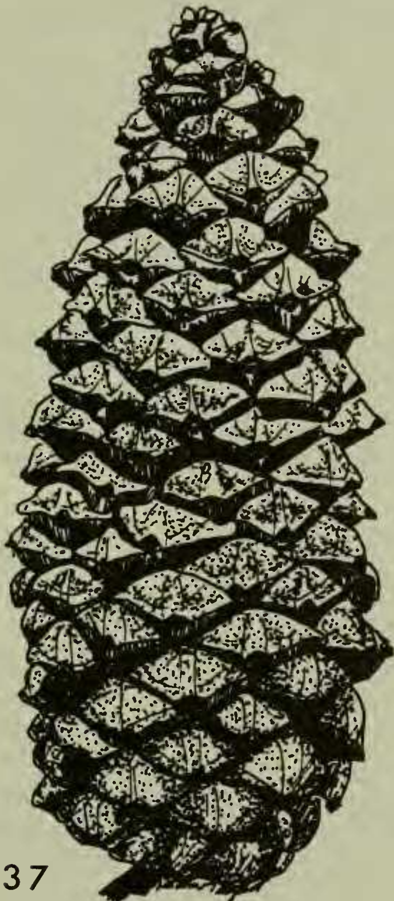

34
B.K.
5530
35
5489
36

Figure 37:

Pinus pinaster Aiton ssp. *pinaster*. Mature seed cone from Corsica. Specimen courtesy of Institute of Forest Genetics (Placerville), Pacific Southwest Forest and Range Experiment Station, U.S. Forestry Service, Berkeley, California. Drawing by Miss Lee-Ann Tegart, slightly enlarged.



37

Figure 38:

Pinus firatii Kasapligil. Holotype: Kasapligil No. 5620 ex Hicri Aksoy from Beşkonak site, in Turkish Museum of Natural History, M.T.A., Ankara.

Figure 39:

Pinus firatii Kasapligil. Paratype: Kasapligil No. 5193 ex Hicri Aksoy from Beşkonak site of Güvem locality, in Turkish Museum of Natural History, M.T.A., Ankara.

Figure 40:

Pinus firatii Kasapligil. Paratype: M.T.A. No. 75-687 in Turkish Museum of Natural History, M.T.A., Ankara.

38

39

40

Figure 41:

Pinus firatii Kasapligil. Paratype: Semra Başaran No. 3 B. Five needles in a cluster, School of Pharmacy, University of Ankara, Ankara.

Figure 42:

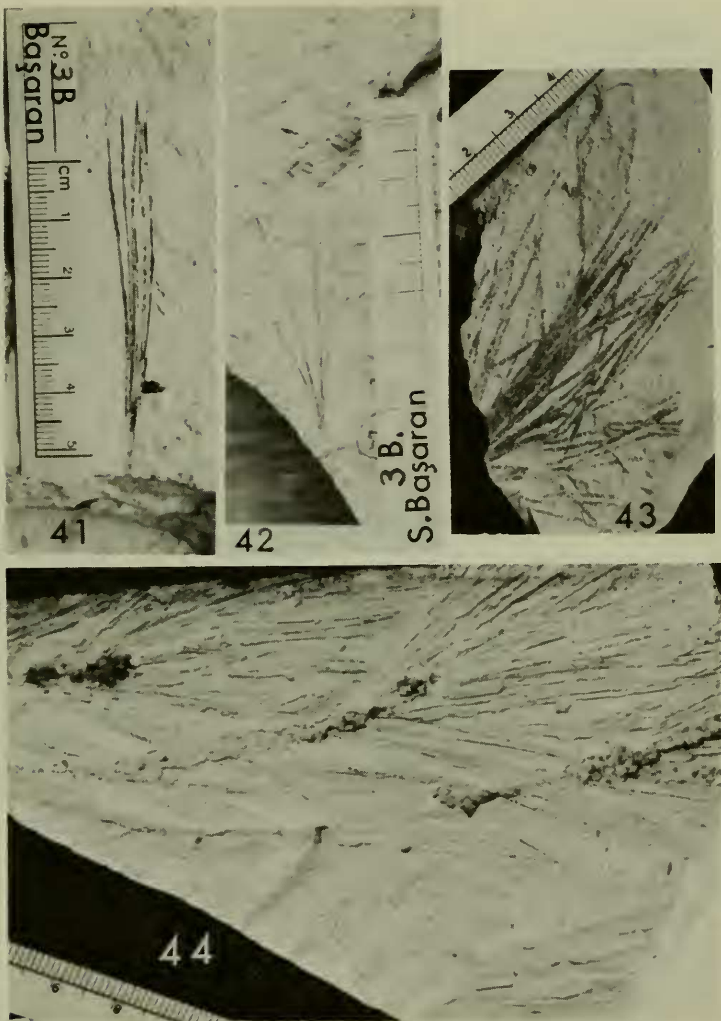
Pinus firatii Kasapligil. Paratype: Semra Başaran No. 3 B. Four needles on a spur shoot, the fifth needle missing, in School of Pharmacy, University of Ankara, Ankara.

Figure 43:

Pinus firatii Kasapligil. Paratype: Kasapligil No. 5621 ex Hicri Aksoy from Beşkonak collecting site, in Turkish Museum of Natural History, M.T.A., Ankara.

Figure 44:

Pinus firatii Kasapligil. Paratype: Kasapligil No. 5619 ex Hicri Aksoy, Beşkonak collecting site, in Turkish Museum of Natural History, M.T.A., Ankara. Note the long and spur shoots with needles attached.


Nº 3B
Başaran
cm
41
42
3B.
S. Başaran
43
44